Photon

Issue 4
Aug/Sept 2004
http://www.nightskyobserver.com/Photon

Getting the Most from Your CCD Images

Ancient Astronomers of Newgrange

I Sent My Rock to Arizona

The Moon by Day

The 2004 Transit of Venus

Processing CCD Images With PaintShop Pro V8

Contents

Issue 4 August/September 2004

Editorial

Welcome to the fourth issue of **Photon**, the new bi-monthly astronomy magazine which aims to fill the gap left by the regular printed magazines.

My thanks go to all the contributors who took the time to send in material and photos for this issue.

Call for Submissions

With the next issue looming, I'm on the lookout for material for that issue. Material has been a bit slow in coming in for the current issue which is one of the reasons its appearance has been delayed.

Photon is written by amateurs like yourself, so if you have a topic or subject that you'd like to tell others about, please do. As I said in my first editorial, **Photon** is designed to be an international magazine. This issue sees articles from Ireland, the United Kingdom, the United States and Canada. I'd like to see material coming in from around the globe. There are two good articles on processing CCD images but I'd still like someone to send in something about using webcams for astrophotography and the software that can be used for stacking images - any takers? But keep the equipment reviews and how-to articles coming in as well.

Software is now a part of the amateur astronomer's arsenal of tools. Whether you simply use planetarium type programs for planning observing sessions or some of the freebie software for image processing or creating stacked CCD images, let me know what you think of them, their strengths and weaknesses and maybe how you think they can be improved. No one piece of software seems to provide everything in one package.

A Letters page would be good as well and, depending on the response, I could look at setting up a message board on the **Photon** webpage so folks don't have to wait till the next issue for an answer to a query!

Everybody has a funny story to tell about astronomy or some astronomical event they've been at, so send them in, no matter how small.

I'm always on the lookout for astro-photos to use in the magazine, so please send in your images (and include as much info as possible on what equipment was used to take the photo, exposure times, etc.) Webcam and CCD astrophotography is now a huge interest area so if you use such equipment, let me know your experiences with it and the results you've achieved (good or bad).

If you're submitting large astrophotos for consideration, they'll be scaled down to fit in the magazine (and save space) but if you want to provide a web address for the original full-size image, I'll include those with any photos used.

People love reading about other people, so why not take the time to talk about yourself or your club/society (as with the article from the Des Moines Astronomical Society in this issue).

Photon is also on the lookout for advertisers. If you would like to advertise (or know anyone who does) please contact the editor at the address below for rates.

I hope you enjoy Issue 4.

Gary Nugent
photonmag@excite.com
http://www.nightskyobserver.com

Did you Know?

Comet Ferret

Charles Messier (whom Louis XV dubbed the "comet ferret") was once obliged to abandon his search for a certain comet in order to tend to his dying wife. Messier was soon dismayed to learn that the comet had been discovered by a rival astronomer, Montaigue of Limoges.

Some time later, a friend, hearing of his wife's death, expressed his sympathy for Messier's "loss." The astronomer nodded pensively. "To think that when I had discovered twelve," he said, tears pooling in his eyes, "this Montaigue should have got my thirteenth!"

Two Moons

In 1610, Galileo used an anagram to announce his discovery of what he believed to be two moons orbiting another planet: smaismrmilmepoetaleumibunenugttauiras.

Remarkably, Johannes Kepler, after considerable effort, managed to decipher the code, Salve umbisteneum geminatum Martia proles ("Hail, twin companionship, children of Mars"), thereby confirming his own prediction that Mars has two moons.

More remarkable still, Galileo's cypher had in fact declared: Altissimum planetam tergeminum observavi ("I have observed the highest of the planets - Saturn - three-formed")!

[Galileo had mistaken Saturn's rings to be twin moons.]

Getting the Most from your CCD Images

By Tim Long

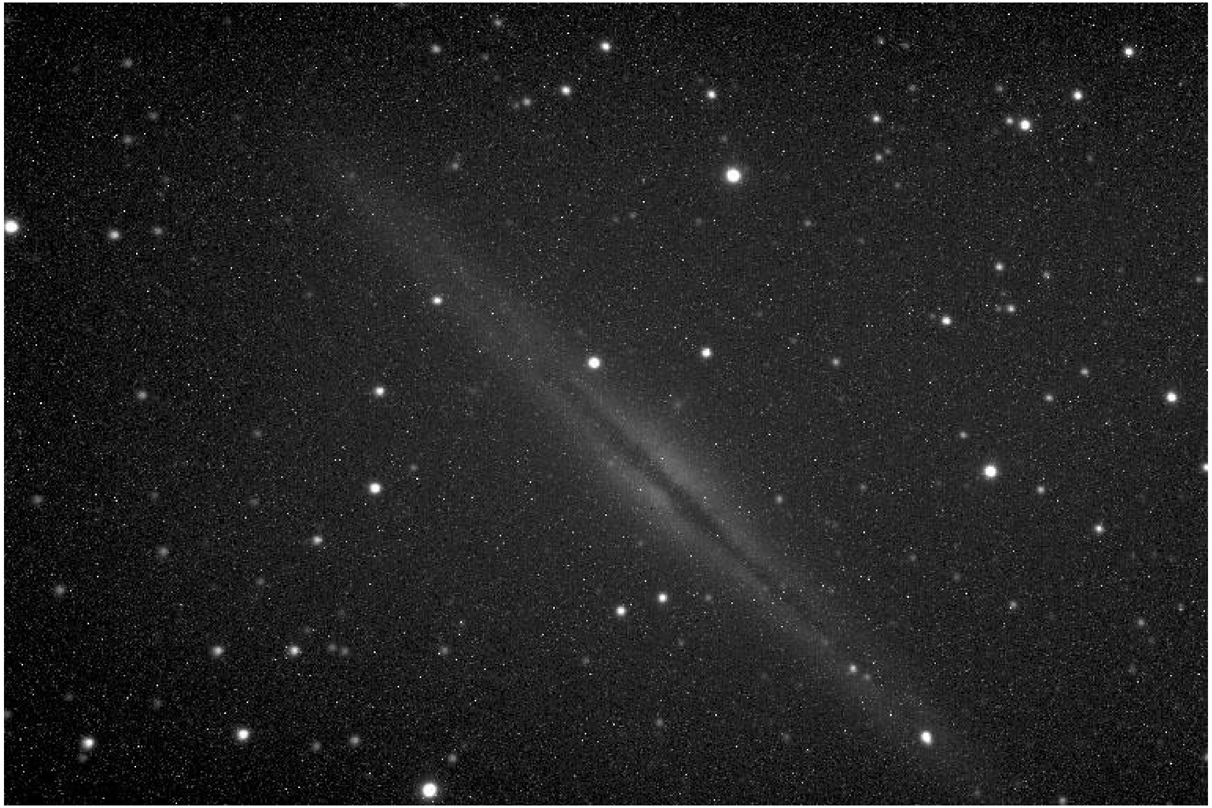
Plenty has been written about how to take good CCD images but a subject that is sometimes overlooked is making the most of the data you have captured by removing noise from the images.

In this article, I will concentrate on making the best use of the image data by producing very high quality noise reduction frames. An essential technique in CCD imaging is *noise reduction*. Various techniques are used before during and after taking the image to improve the signal to noise ratio. Noise sources are many and various but perhaps by far the most significant is noise produced by the camera and CCD detector itself, known as [*dark current*](). Dark current is minimized by cooling the CCD detector using a [Peltier device](), but cooling never eliminates the noise completely. Dark current manifests itself as 'snow' in the image and graininess of the background, but luckily the noise is fairly predictable and can be removed by the simple yet ingenious technique of taking a picture with the camera shutter closed (therefore capturing only the noise) then subtracting this *dark frame* from the actual image. This process is known as *image reduction*. This simple technique will drastically improve the quality of most images and many camera control applications offer an 'auto-dark' feature that automatically captures a dark frame as necessary and subtracts it from the image.

Using AutoDark with a single reduction frame is very useful during focusing, framing and for taking pointing exposures because it is quick and easy and requires no user input. However, using AutoDark for the actual image acquisition has serious limitations and will not yield the best results.

The Nature of Noise

The problem with noise is that it is a statistical animal and although it is often fairly repeatable, it is never exactly repeatable. So a single reduction frame will



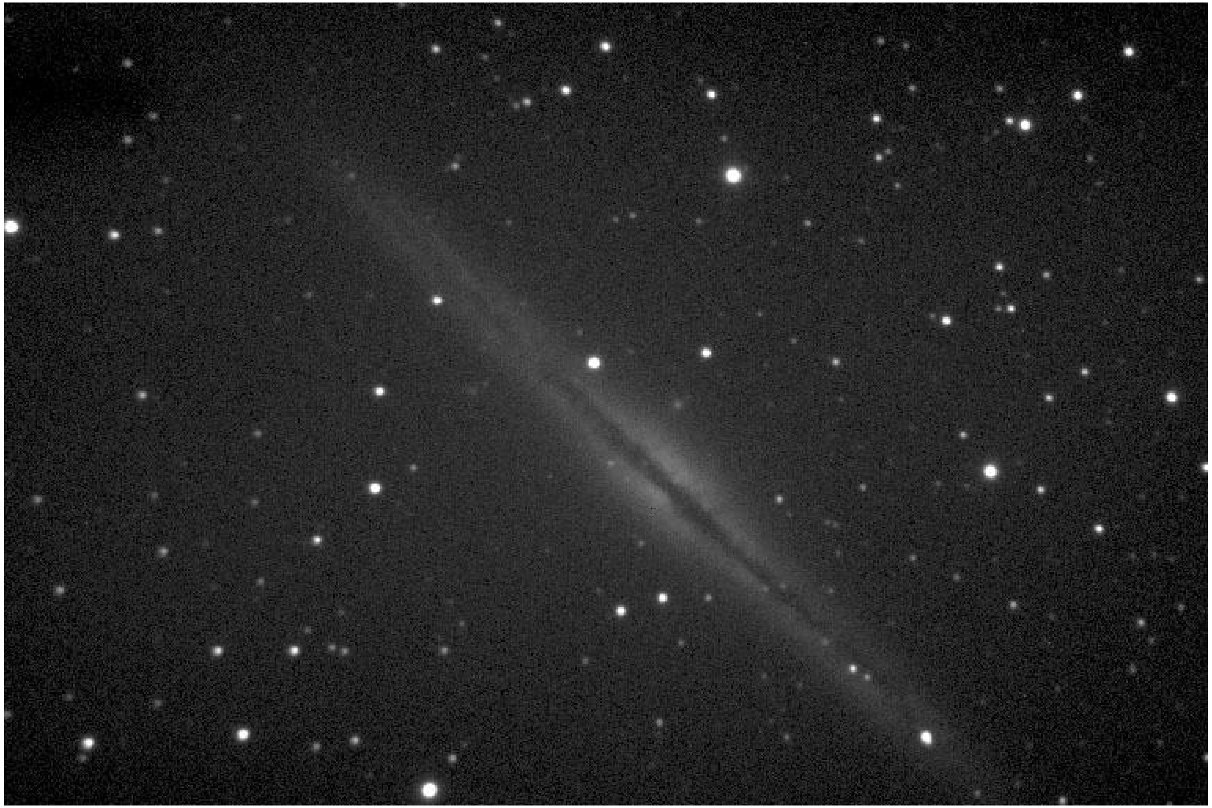
A typical raw frame captured by a CCD camera showing noise within the image. The subject is NGC 891. Raw frame from the CCD camera, taken Oct 2003, cooled to -30C, exposure 480 seconds at f/10

never accurately represent the actual camera noise. There are also other sources of noise, such a light leaks and cosmic ray hits that make it impossible to produce the perfect dark frame on any given attempt. A cosmic ray hit, for example, can appear as a blob, smudge or streak in the image. If a dark frame containing a cosmic ray hit is used to reduce an image, then too much noise will be subtracted from the image and may be visible in the end result.

The solution is never to rely on a single reduction frame. Just as stacking images improves the signal quality, stacking reduction frames can improve the quality of the noise! Subtracting good quality noise from an image gives better results than subtracting low quality noise because high quality noise more accurately represents the actual noise present in the camera and has less random variation. Commonly, multiple reduction frames will be captured then somehow averaged to produce a single higher quality *master frame*. The average is calculated pixel-by-pixel, taking the same pixel from each of the reduction frames and applying some sort of mathematical process to the values, then storing that new value in master frame. This new higher quality frame is then used to perform the image reduction. Most camera control applications also have features to support this technique, making it convenient to use.

How do we calculate the average? Different techniques have different benefits and none produces perfect results. Perhaps the most intuitive technique, the arithmetic mean, works well unless there is a gross error in the data, such as a cosmic ray hit or a hot pixel. Gross errors can have a large effect on the mean value, so this may not be as good as first thought. Another commonly used technique is to use the median value. This has the advantage that it eliminates gross errors (such as cosmic ray hits) from the result. However, the result of a median combine is essentially throwing away all but one of the pixel values images.

A technique that is starting to become more popular now is the use of statistical techniques. Using a much larger number of reduction frames, perhaps fifty or more in a single operation, a sigma-reject algorithm is applied to the pixel data. Not being much of a mathematician, I can not really do justice in describing how sigma reject works. In simple terms, sigma reject analyses the pixel values and rejects any values that are obviously bad. Once these outliers have been removed, the remainder of the values can be averaged using the



The NGC 891 image reduced using a -30C 600 second master dark frame scaled to 480 seconds using a master bias frame. Unfortunately I do not have a record of how many individual dark frames went into this master, but I normally use around 50.

arithmetic mean. This seems to be the best of both worlds. Bad data is eliminated while the good data all contributes to the resulting master frame, which may be of very high quality and will produce far better results than a simple average of a few frames. The main disadvantage of this technique may be obvious; a large number of reduction frames is required, which takes a lot of time and effort to produce.

Why Use a Reduction Frame Library?

So, to get the best results, we need to use a large number of frames and use statistical methods. The most efficient way to manage that many frames is to build a library, and re-use frames from the library as needed. However, conventional wisdom tells us that reduction frames tend to be better quality if they are taken at the same time as the images themselves. This presents us with a dilemma. We can get better quality frames by taking them on the night, but this would make it impossible to take enough frames at a single sitting. What to do? Well, first let's understand that conventional wisdom does not really take into account the statistical techniques such as sigma combining. Conventional wisdom is concerned really with the simple averages that we already decided were not making the best use of the data available. Under those circumstances, using a small number of images with a simple average, it is probably true that taking the reduction frames on-the-night gives better quality results. However, it has been my experience that using a large number of frames from a library and sigma-combining them produces far superior results.

Better quality results is a compelling reason to produce a reduction frame library. Another compelling reason is the increased convenience of a library over taking new frames at each sitting. The frames can be acquired during times when the telescope is not in use, perhaps even during the day, and stored for later use. Master frames can be produced in advance and are then always available for quick and easy use whenever needed. This reduces the amount of wasted telescope time and the process lends itself to automation. The camera can be instructed to take large numbers of reduction frames then left unattended to complete the operation.

Because noise is temperature-dependent, reduction frames must be taken at the same temperature as the images. Atmospheric conditions vary and that means images will be taken at various temperatures. The reduction frame library will therefore need to contain large numbers of frames taken at different temperatures, resolutions and exposure lengths. I wrote an application that I call Dark Manager to do just that. Using CCDSoft version 5, Dark Manager will accept a specification for what frames should be in the library,

Eight reduced frames aligned and combined, histogram adjusted and deconvolved using CCDSharp.

then it will go about acquiring those frames completely automatically. This can be a huge time saver and allows the library to be built at a convenient time when the telescope is not being used, on rainy nights or even during the day. The application can be downloaded from my web site at http://syd.tigranetworks.co.uk where there is also more information about how DarkManager supports the work flow necessary when using a library.

Work Flow

Getting the best results from a reduction frame library requires a slightly different workflow to the traditional method. The technique described here is that used by me, Tim Long, the author of DarkManager. No originality is claimed; this technique was derived from various posts on various imaging newsgroups, notably on Ron Wodaski's CCD-Newastro group. DarkManager was written specifically to support this technique.

Build the Reduction Frame Library

My personal library consists of a minimum of fifty frames at each of a range of temperatures. I take all of my dark frames at 10 minutes (600 seconds) duration. We did not discuss bias frames, but these are necessary to enable dark frames to be scaled to match images of different exposure times. It turns out that the high-quality frames produced by sigma combining scale very well within certain limits, reducing the actual number of frames that need to be taken. An equivalent number of bias frames needs to be taken and sigma-combined in exactly the same way as the dark frames. The master bias frame can then be used to scale the master dark frame.

I do not try to build the whole library in one go. It is better to build smaller batches of frames on different nights. Depending on the season, some temperature set points will not be appropriate, for example, I can only cool to around 0C during high summer but in the winter I can often get down to -30C. So I concentrate on different temperatures at different times of year. Currently, I am not doing much colour imaging so I take all my reduction frames binned 1x1. If colour imaging is a requirement, then DarkManager can easily accommodate binned exposures.

Discard old frames

Camera characteristics tend to change slowly over time, perhaps over a few months. This will vary from one make and model to the next and between different individual cameras of the same make and model. So, after a certain time, old reduction frames will no longer be representative of the actual noise and defects present in the camera. The easiest way to remedy this is simply to discard (delete) old frames. New frames can then be taken to replace the old, deleted frames. By rolling in new frames occasionally, the library is maintained at full compliment, while ensuring that the frames are relatively up-to-date and representative of the actual camera characteristics. I discard frames older than 4 months from my library. When new frames are added to the library, new master frames must be produced.

Produce Master Frames

The point of keeping all these reduction frames is to enable the production of high-quality master frames. Typically, for each new image, I will produce a new set of master frames from the library. Currently this must be done with a third party utility such as Ray Gralak's *Sigma*. A future version of DarkManager will incorporate this function. I aim to use 50 dark frames and 50 bias frames, to produce two master frames (dark and bias). Combining this many frames needs a lot of memory and can take some time to complete. I store my master frames along with my image data so I always have a record of which reduction frames were used.

Reduce the Image Data

This is done in the traditional way. In CCDSoft, a reduction group can be created containing the two master reduction frames. This reduction group can then be easily applied to a whole folder of image frames.

Future Plans - Reduction Frame Utopia

DarkManager is a work-in-progress and will be improved over time. Ultimately, I hope to produce a product that will ensure that reduction frames are always available, on tap, whenever they are needed, with no human intervention whatsoever. I hope to produce a program that will automatically run at scheduled intervals, discarding old frames, acquiring new frames, combining the frames to produce master frames. As such, CCD imagers will never need to worry about producing reduction frames, because a fresh, up-to-date set will always be available ready for use.

The first part of this vision is already a reality. DarkManager is available for download today and can automate the acquisition of your reduction frame library and assist in recognising 'Aged' frames, missing frames and surplus frames.

The second part of this vision is currently under construction. A sigma-reject algorithm is being developed that will allow DarkManager to combine the frames in the library to produce the master frames needed. This will be able to operate on selected frames, or the whole library in one operation.

The third and final phase will concentrate on scheduling (using Windows task scheduler) and the complete automation of the reduction frame work flow.

the ancient astronomers of newgrange

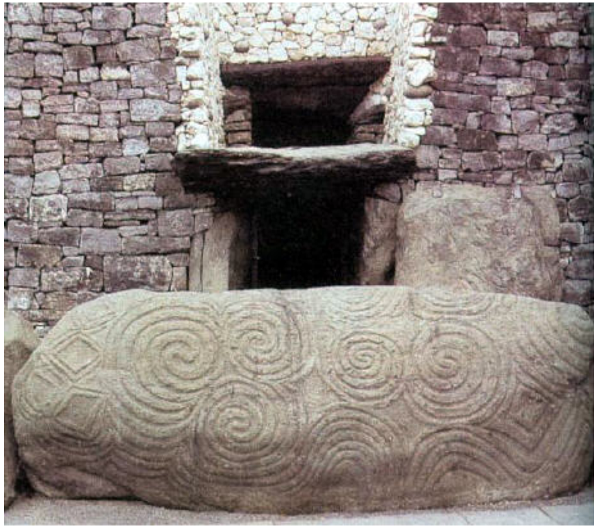
By Anthony Murphy

The Newgrange mound in the Boyne Valley, Ireland

Some time after 6,000 years ago, there arose a remarkable community of people in Ireland. As if from nowhere, these astute, organised, intelligent and capable people claimed their stake on this country and began constructing permanent, indelible monuments which were to stand the test of aeons of time. They were the megalithic builders.

Their constructions are Ireland's best known, most explored, and possibly least understood, monuments. The most famous of these, Newgrange, is a magnet for tourists, who flock to the Boyne Valley every year in huge numbers. In 1999, there were 297,000 visitors to Newgrange, and numbers have been rising steadily. The nearby megalithic passage mound at Knowth has recently opened to tourists also, and the third major Brugh na Boinne site, Dowth, is also open to the public. So what is it that attracts people to these sites? What do they come to see? What are they told about these remarkable monuments?

Even to the casual visitor, it is clear that there is something distinctly mystical about Newgrange, Knowth and Dowth. The stark symbolism etched deeply into the huge megaliths is a written record which comes to us across over five millennia. At Newgrange, the huge stone outside the passage entrance is highly decorated with huge, swirling spirals. At Knowth, nearly every stone is decorated, and the site has been hailed as having the largest collection of megalithic art in all of Europe - in fact, over a quarter of all known megalithic art in western Europe is at Knowth and its satellite mounds. Two miles to the east at Dowth, there are more decorated stones. At Loughcrew, 40 kilometres west of Brugh na Boinne in County Meath, there are the ancient cairns of Sliabh na Cailligh, the mountain of the witch, again featuring vast amounts of ancient carvings.



The massive curbstone (10 feet x 4 feet), in front of the entrance to Newgrange, is carved with spirals and lozenges

Among the familiar patterns, such as zig-zags, waved lines, spirals and lozenes, there are some decorations which are distinctly astronomical in nature. At Dowth, there are stars and sunwheels, at Newgrange there's carvings that look like a representation of Orion's Belt, at Knowth there is a wealth of astronomical imagery - crescents and moon shapes, stars, circles, spirals, sundials and astral imagery, and possibly even a map of the moon. At Loughcrew there are suns and sunwheels, stars and much more. Could it be that these sites share a common astronomical purpose? Are we looking back through the murky mists of time to an enlightened epoch, a time when men and women of great intellect and ability mastered their study of the heavens and recorded what they saw for posterity?

There is a dim light which shines from the remote distance of the Neolithic past. It carries a message of wisdom, of understanding, of cosmic awe and inspiration, and astronomical mastery of the highest order.

We have regrettably looked upon the ancient people of this land as being primitive, and in some quarters we are told that these awesome constructs with their dazzling size and arcane symbols, are merely tombs, used to bury the dead. Even today, archaeology calls Newgrange, Knowth and Dowth "passage-tombs". I would like to see that title removed, and to install a more accurate and fitting description - something like "astronomical timepieces" or "Stone Age observatories".

Pick up almost any amateur astronomy book at your local bookstore and in the history of astronomy section you will invariably read that the first astronomers were the ancient Babylonians, or the Chinese. You will also read about how the Greeks helped to enlighten the world with their many scientific and astronomical discoveries. Some of these books are progressive enough to mention that there were ancient astronomers at Stonehenge, but most overlook Newgrange and Ireland, which is evidently the place where competent astronomical study actually began.

NEWGRANGE / SÍ AN BRU

The Winter Solstice sunrise event at Newgrange, where the sun shines into the long passage on the shortest day of the year and illuminates the central chamber, is the most heralded event in the Irish cultural calendar, and attracts major media attention every year. Most people know about it, and many gather at the famous mound every December to witness the event, even though most of them have to make do with seeing the event from outside. It is a famous example of ancient astronomy in action in modern times, and is a fitting

The Winter Solstice sunrise illuminates the passage way leading into the burial chamber of the megalithic passage tomb at Newgrange

beginning to our exploration of the ancient Irish skywatchers.

At dawn on Winter Solstice every year, just after 9am, the sun begins to rise across the Boyne Valley from Newgrange over a hill known locally as Red Mountain.

Given the right weather conditions, the event is spectacular. At four and a half minutes past nine, the light from the rising sun strikes the front of Newgrange, and enters into the passage through the roofbox which was specially designed to capture the rays of the sun.

For the following fourteen minutes, the beam of light stretches into the passage of Newgrange and on into the central chamber, where, in Neolithic times, it illuminated the rear stone of the central recess of the chamber. With simple stone technology, these wonderful people captured a very significant astronomical and calendrical moment in the most spectacular way.

The chamber and passage at Newgrange, showing the triple spiral, as seen from the end recess.

The sunlight appears to be split into two beams - a higher beam and a lower beam. This is in fact true, the lower beam being formed by the doorway to the passage. It is the light which enters through the roof-box, however, which reaches the central chamber.

For a very short time, the beam of sunlight enters the chamber, illuminating the floor. It is a narrow beam, only 34cm wide at the entrance and narrower in the chamber. Originally, the beam would have struck the rear chamber orthostat (C8) and, possibly, would have been reflected onto another chamber stone, C10, which contains the famous triple spiral. After just 14 short minutes, the beam disappears from the floor of the chamber, retreats down the passage and once again the heart of Newgrange returns to darkness.

With this most famous cosmic moment at the epicentre of our study, we can now expand on the astronomical theme and demonstrate how Newgrange does not stand in isolation as an astronomical device, despite what many people might believe. The Winter Solstice sunrise phenomenon is not the only function of Newgrange. In the book "Uriel's Machine", Robert Lomas and Christopher Knight have speculated that the roofbox and passage of Newgrange may have been used to track down Venus during specific moments in its eight-year cycle. Certainly the evidence for study of Venus is abundant in the Boyne Valley.

The Newgrange roof-box lintel

Above the roofbox of Newgrange, there are a series of eight markings, which the authors have suggested could represent the eight years of the Venus cycle. This eight-year cycle of Venus ties in very closely with the metonic cycle of the moon, and may have been recorded elsewhere at Brugh na Boinne as we will see later.

But it doesn't stop there. Many astronomers will know that the moon's path through the sky, although inclined slightly to the sun's path, will take it into positions which are shared by the sun at certain times of the year. The points where the imaginary line of the moon's path crosses the line of the sun's path are called nodes. It is when the moon is at a node that it

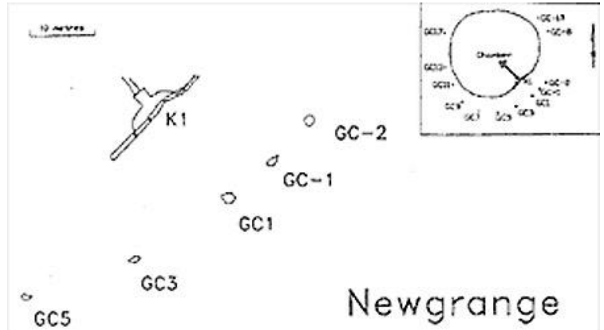
sits on the ecliptic, and when the nodes are located in Gemini and in the gap between Sagittarius and Scorpius, then the Moon shares the sun's Summer Solstice and Winter Solstice positions.

This only occurs twice during a single rotation of the nodes, which takes 18.6 years. So every nine years, on just a few occasions, a full moon or waning gibbous Moon which rises in the Sun's Winter Solstice position can, technically speaking, shine into Newgrange, or at the very least line up with the passage and chamber.

On July 5th 2001, a group of amateur researchers (most of whom I know, including Richard Moore), were given special permission by Duchas to access the Newgrange chamber to see if they could witness the full moon from the interior of the chamber. Regrettably, some cloud cover meant the Moon was obscured for the crucial minutes after it rose, but the cloud did clear in time to allow the group to see the Moon from within the passage. Although this observation did not prove conclusively that the Moon can be seen from the chamber, it goes without saying that if the Moon's position can coincide with that of the Winter Solstice sun, then the alignment is true.

There may be more evidence to support a lunar function at Newgrange. The front of the mound is decorated with a brilliant façade of milky-white quartz, and some researchers and archaeologists believe the whole mound may originally have been covered with this brilliant stone. Perhaps Newgrange was supposed to be the earthly reflection of the Moon?

Speculation aside, it is clear that more research needs to be done on this aspect of the astronomy of Newgrange. The Irish name for Newgrange is *Brugh na Boinne*. The word *Boinne*, from which the River



Positions of the large standing stones in front of the entrance of Newgrange

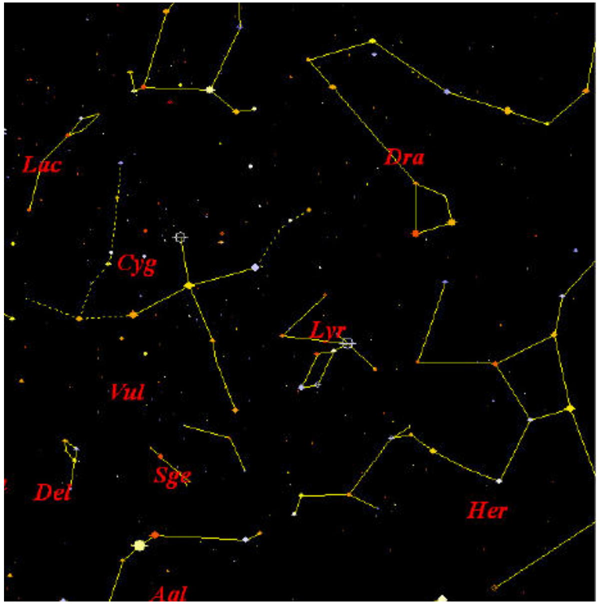
Boyne is derived, means "White Cow", and the ancient goddess Boann may have been associated with the Moon. Indeed, some researchers have pointed out that the period of gestation of a cow is equivalent to nine and a half synodic lunar months. The word *Brugh* is interesting too. Traditionally it has been interpreted by academics as meaning "mansion" or "house", but there is a word *Brú* which I have found to mean "womb" (MacCionnaith Foclóir, 1938). Could the real meaning of Newgrange be "The womb of the Moon???" The symbolism and interplay between the various elements involved leads to further speculation about the whole purpose of the site. We can imagine a full Moon rising over the hill of Red Mountain, shining across the valley, over the Boyne River, which has the same meaning as the Milky Way in the sky, and may in fact have been seen as its earthly reflection. The Irish for Milky Way is "*Bealach*, or *bothar*, *an Bó Finne*" - the way or the road of the white cow. Perhaps the quartz façade on the front of Newgrange is supposed to be another representation of the Milky Way.

Perhaps some day we will see spread across the front pages of the world's newspapers the wonderful image of moonlight flooding into the chamber of Newgrange.

Serious academic research, as opposed to that of us amateurs, has also revealed interesting astronomical functions at Newgrange. Archaeoastronomer Frank Prendergast has produced data which shows that even the large standing stones in front of the entrance of Newgrange, known as the "Great Circle", were astronomical and calendrical in function. Although carbon-dating has placed the construction of the Great Circle to about 2000BC, over a thousand years after the construction of Newgrange itself, Mr. Prendergast shows that the stones functioned properly at that time. His research demonstrated how the shadow of GC1, the megalith adjacent to the entrance, would have crossed the lower part of the three spirals on the west side of K1 at the winter solstice; that the shadow of GC-1 would have crossed through the centre of the three spirals at the period when the south declination of the sun was half its annual maximum; that the shadow of stone GC-2 similarly crosses the same three spirals at the equinox; that the alignment of GC5 to GC3 pointed towards sunrise when the north declination of the sun was at half its annual maximum; it would also have been possible to observe the summer solstice sunrise by sighting across the top of GC1 and GC-2.

Our own work has shown how the astronomers of Newgrange may also have used the star Deneb, in the swan constellation Cygnus, to help track down the position of the sun during the night before Winter Solstice. The mystery is heightened by the attachment of certain swan myths to Newgrange, such as the famous romance story of Aonghus and Caer. Aonghus' mother was Boann, the Moon, and his father, the Dagda, owned Newgrange.

The story tells how Aonghus fell madly in love with a



Cygnus and nearby constellations may be represented at Newgrange

maiden who visited him while he slept. She visited him in his dreams for a year, and all this time he could not touch her because she would disappear. His mother Bóann searched Ireland for the maiden, but was unable to find her after a year of searching. Aonghus enlisted the help of his father, the Daghdha, who in turn sought out Bodhbh, who was the Tuatha Dé Danann king of Munster. Bodhbh revealed that the maiden was, and brought Aonghus to meet her at Loch Béal Dragan (Dragon's Mouth) in Tipperary. Bodhbh explained how Caer was from Sídh Uamhain, an 'otherworld residence' in Connacht.

Caer's father revealed to the Daghdha that his daughter went in the forms of a bird and a girl on alternate years. At the following Samhain (November) she would be a bird at Loch Béal Dragan, and the Daghdha instructed Aonghus to go there and call her to him. He did so, and found her in the shape of a beautiful white swan, in the company of thrice fifty others. She went to him, and he too became a swan, and they embraced each other and flew three times around the lake. They then flew together to Brugh na Bóinne and put the dwellers of that place to sleep with their beautiful singing. Caer remained with Aonghus in the Brugh after that.

The story says they took the form of swans and lived **IN** the Brugh. Is it purely coincidence that the swan constellation is cruciform in shape, like the Newgrange passage?? Maybe, and we have to remember there are other cruciform passages in ancient megalithic mounds and cairns in Ireland. But the mystery deepens with the addition of the Fourknocks alignment.

Not a lot of people seem to know this, but if you plot the line of the direction of Winter Solstice sunrise from Newgrange on a map, this line intersects the small Megalithic mound of Fourknocks, 15 kilometres to the southeast.

(INFO: Sunrise 3150 +/-100 BC = 133°54 +/-4' Range of azimuths calculated by Prof. Tom Ray: 133°49' - 137°29)

So in other words, Newgrange 'points' to Fourknocks, although Fourknocks is not visible from Newgrange. Fourknocks, in turn, points to a very unusual azimuth - around 17 degrees east of north, way beyond the northernmost range of the rising Sun or Moon. What we need to resolve is whether the passage of Fourknocks is aligned on a significant star, or constellation.

And, in the epoch when this small mound was constructed, between 3000 and 2500BC (Gabriel Cooney), the star Deneb would be rising at this point.

The second significance of Deneb relates to its precessional importance. Throughout the entire 26,000 cycle of precession, Deneb remains mostly a circumpolar object, never setting below the horizon and being visible to observers at this latitude every night of the year.

But interestingly in the epoch 3000 to 2500BC, Deneb is at its lowest point in the entire precessional cycle. At this time it grazes the horizon, and just about sets below the horizon at due north briefly during this time, before rising again to remain visible to those who would wish to watch the star.

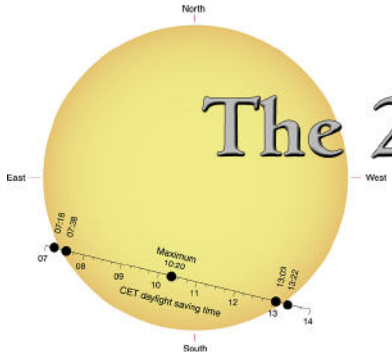
Another aspect of the Aonghus-Caer romance is interesting. It is the reference to the "Lake of the Dragon's Mouth", where Aonghus found Caer. This could be a possible reference to the constellation of Draco, which is a prominent constellation in the northern hemisphere of the sky.

The constellation is particularly relevant in the Neolithic period, because the main star of Draco, called Thuban, was the pole star for a few hundred years around the date 2,800BC. It is also fascinating to our story in light of the fact that Cygnus the constellation is located very close to the head of the dragon in the sky.

To be continued

Anthony Murphy maintains two megalithic websites:

Mythical Ireland
101 Facts about Newgrange



The 2004 Transit of Venus

By Kevin Berwick

"We are now on the eve of the second transit of a pair, after which there will be no other till the twenty- first century of our era has dawned upon the earth, and the June flowers are blooming in 2004. When the last transit season occurred the intellectual world was awakening from the slumber of ages, and that wondrous scientific activity which has led to our present advanced knowledge was just beginning. What will be the state of science when the next transit season arrives God only knows. Not even our children's children will live to take part in the astronomy of that day. As for ourselves, we have to do with the present…."

William Harkness, US Naval Observatory, August 1882

On the 8th of June 2004 the planet Venus passed in front of the Sun. The event was widely predicted and the whole event was visible from Europe. A transit of Venus is a very rare event. Transits of the planet occur in pairs 8 years apart. However, each pair is widely separated by either 105.5 or 121.5 years from the next pair.

No person alive today had seen a transit until the 8th of June 2004. So the opportunity was presented to me to witness an event in real time that nobody else on the planet had seen. In addition, I intended viewing at least some of the event in the deep red light of Hydrogen-Alpha. The technology to view the Sun in Hydrogen-Alpha was not available at the last Venus transit making me one of the first people ever to view such an event in H-Alpha. Who could resist such an opportunity??

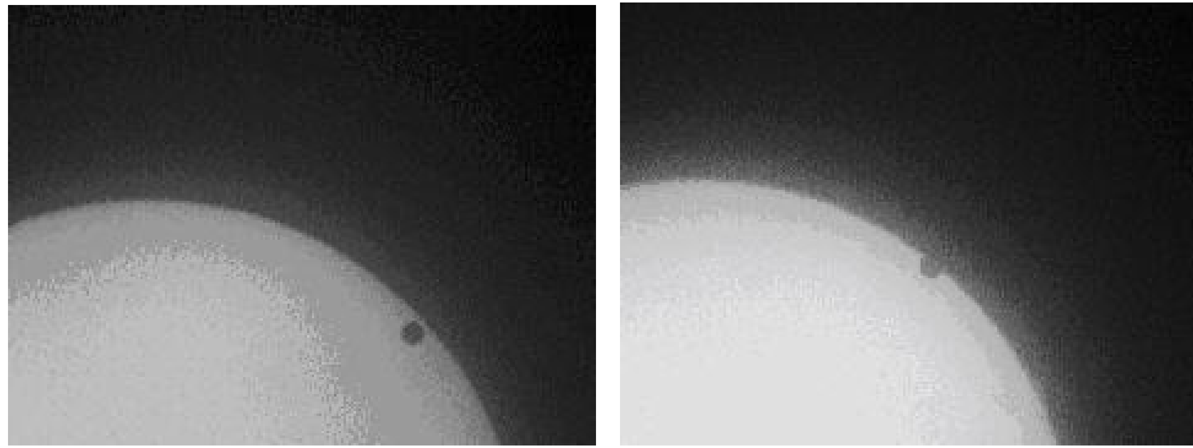
Work commitments prevented me from going abroad to view the event, so I had to take my chances with the Irish weather. As the 8th of June approached, I mentally prepared for the event by practicing a sense of crushing disappointment! …and praying for clear skies.

I set my alarm early on the morning of the 8th since first contact of the planet with the Sun's disk was around 5 am UT. It was very misty here on Dublin's South Coast when I got up but I hoped that the Sun would burn it off and we would get clear skies for at least some of the event. After breakfast, I carried out my solar scope, a Takahashi Sky 90 on a Vixen Custom – D alt-az mount, equipped with a Coronado Solar Max 90 filter. With this I could view the transit in H-alpha and, by detuning the filter, could also get a broadband view similar to that you would see using a white light filter, only the Sun would be coloured red. I noted that the garden looked very well, a dazzling display of 6 foot high foxgloves forming a beautiful backdrop for my scope, as predicted by William Harkness.

I set up my telescope at the end of the garden, in order to catch the low Sun over the houses of my neighbours. Needless to say, the telescope was pointing almost directly above the bedrooms of nearby houses. Early risers would no doubt be able to confirm their suspicion that observational astronomy is merely an excuse used by Peeping Toms to provide an alibi for their grubby perversions.

I missed first contact, when the planetary disc first appears to touch the Sun, and second contact, where the trailing edge of the planet touches the edge of the Sun. At around 5:30 am UT, I was still waiting for the clouds to clear, although things were definitely starting to look a lot more promising than they had when I had got up. At 5:36 am UT, I noticed a colourful prismatic halo around a foggy Sun. By 5:44 am UT I could even see some prominences on the Sun with the H-alpha filter through the haze. Indeed, I could even start seeing some detail in the chromospheric network. Venus looked simply like a black disc against the Sun, like a very large perfectly circular sunspot. The disc of Venus has an apparent diameter of 1/32 of that of the Sun, so it was very obvious. No evidence of an atmosphere on Venus on my viewing. It literally looks like a hole in the Sun!! I followed the Sun for the full event through variable cloud cover. I suppose I got about 3 minutes when I could view the transit in all it's glory, in a perfectly clear sky. At these times, the H-alpha detail on the Sun was glorious and the hole in the Sun really added to the visual excitement of the scene. When the

The scene in my back garden as I waited for the clouds to clear on the morning of June the 8th. Note the 'June flowers blooming' in the bottom of the picture, bang on time as predicted by William Harkness, US Naval Observatory, in 1882 . All flowers are courtesy of my wife, Paula Roberts.



The transit just before and after 3^{rd} contact. Taken with Takahashi Sky 90/ Coronado SolarMax 90/BF10 and Philips Toucam Pro Webcam, processing with Adobe Photoshop

clouds really rolled in for about an hour I managed to organise a bacon and egg sandwich to keep body and soul together, after the waft of rashers rolled in from a nearby house. I did catch 3^{rd} Contact, when the disc of the planet touches the limb of the Sun after transiting the Sun and also 4^{th} Contact, when the planet clears the disk and the transit finishes.

Just before I finished, the painter working on the house next door, intrigued at my antics, asked if the could take a look. He seemed genuinely impressed, much to my surprise since it is generally my experience that members of the public rarely find views through even a large telescope very exciting, unless you are showing them the Moon. As the eclipse ended in early afternoon, the sky predictably cleared. Strangely, I wasn't irritated that this hadn't happened earlier to enhance my viewing pleasure. Rather, I was enormously grateful that the sky had at least cleared momentarily to allow me to see the eclipse, particularly since the conditions were not at all promising when I rose.

I may get one more chance to see a Venus transit on June 6^{th} 2012 but for various reasons the event in 2004 was far more favourable for us here in Ireland. To conclude, I feel an enormous sense of privilege that I have had the opportunity to view such an ultra- rare event once in my lifetime.

I may get one more chance to see a Venus transit on June 6^{th} 2012 but for various reasons, the event in 2004 was far more favourable for us here in Ireland. To conclude, I feel an enormous sense of privilege that I have had the opportunity to view such an ultra-rare event once in my lifetime.

Did You Know?

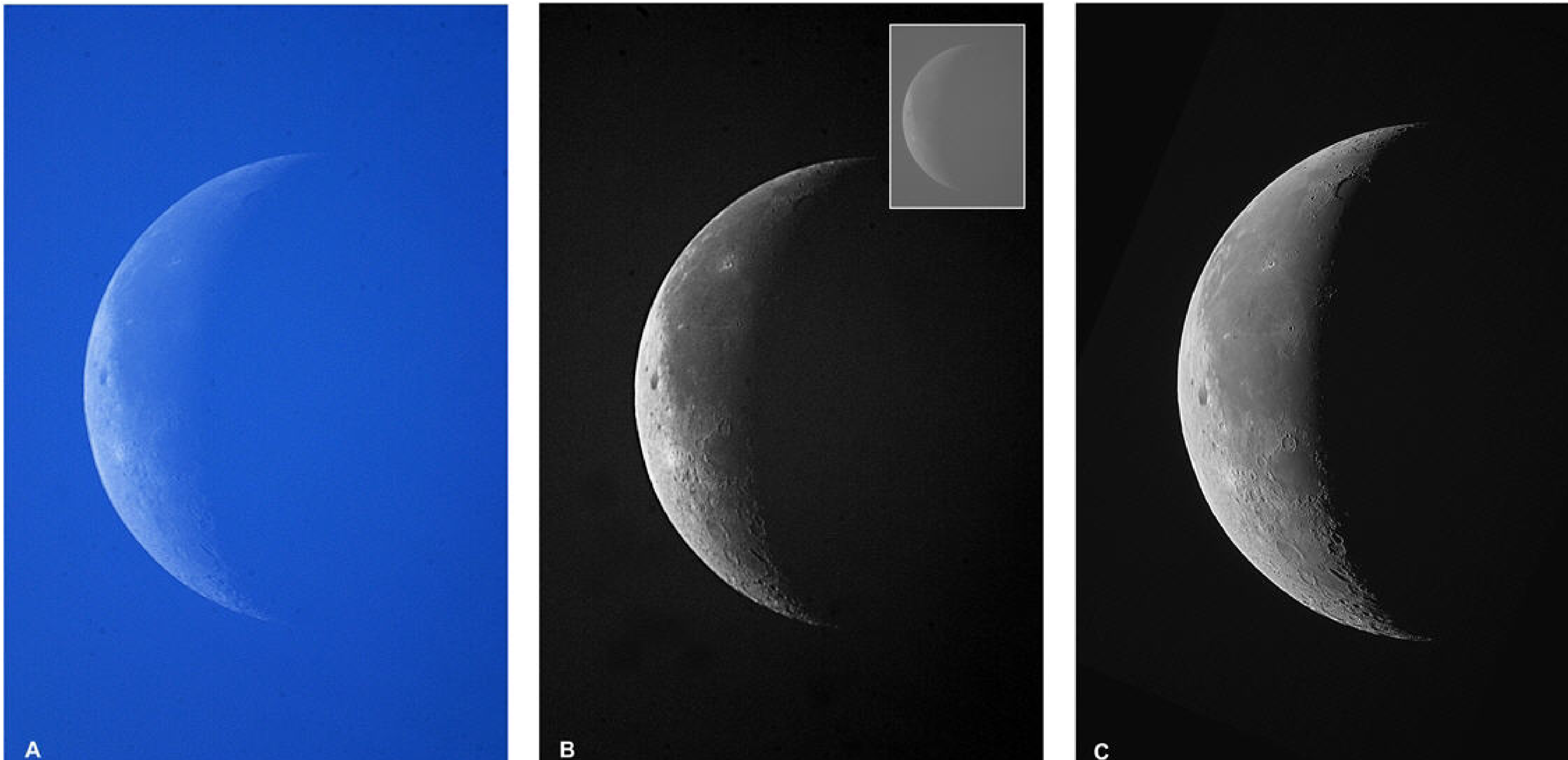
Sir William Herschel (1738-1822), the German-born British astronomer, Royal Astronomer under George III (1782) and noted for his discovery of Uranus (in 1781), was an aspiring musician who became a leading figure in musical circles in the fashionable resort town of Bath before turning to astronomy, a field in which he was entirely self-educated.

Finding contemporary telescopes inadequate, he built his own (the best instruments in the world) with the aid of his spinster sister, Caroline. Herschel would grind lenses for hours and hours while Caroline read aloud to him and fed him food one mouthful at a time. (Caroline also did astronomical work of her own, discovering eight comets).

The Moon by Day

By Douglas Arnold

While imaging the Moon is an enjoyable night time activity it is possible that on occasion it may have to be recorded during the day time. This may arise, for example, because a project is being undertaken to record lunar phases and in a particular case it has not been possible to image the Moon during the hours of darkness, perhaps because of cloud or the observer's



personal circumstances. Obviously, the chance to image the Moon during daylight hours will be far more extensive during the period of the waning than the waxing Moon. While it may be that the time scale of a project will allow the postponement of activity for the night hours until some months later, it is possible to image the Moon in daylight with reasonable quality.

That this can be done and the Moon then rendered as though it were in a dark sky arises from the versatility of digital imaging. Reproduced here are three images of a 24-day waning crescent. Image A is a colour digital image recorded by a Nikon D1 camera attached to a Starfire f/9 178mm refractor at 08.49UT on 2004 September 9. The sensor was rated at the equivalent of ISO200 and the exposure was 1/350th second. September is the best time for imaging the waning crescent and the Moon was high at an altitude of 57°. The scene is approximately as the eye would see the Moon although not at this enlarged scale. The original of image B was taken shortly afterwards in black and white mode and its appearance was initially as 'thin' and lacking in contrast as the colour image (inset). However, the application within Photoshop of functions which enable the density, contrast and detail in an image to be enhanced ('levels', 'curves' and 'unsharp masking') has resulted in an image which might be supposed to have been taken during the night. Numerous features are plainly visible. Close to the limb at mid-frame is the dark floored crater/basin Grimaldi and far to the north in the Oceanus Procellarum is the bright complex feature of the craters Herodotus and Aristarchus with Vallis Schröteri. To the south, the Mare Humorum is clearly visible with the crater Gassendi prominent. Further south still are the large craters Schickard and (looking like the head of a spear) Schiller.

Image C was taken on a previous occasion (the phase is slightly earlier) at night. It is considerably better than B as would be expected: the early morning hours are subject to less atmospheric turbulence and the lunar surface of a disc in a dark sky exhibits good contrast which facilitates more accurate focussing and better quality generally in the resulting image. A record obtained under optimum circumstances will always be superior to one secured under less favourable conditions and subsequently improved. Because of the reduction in size in the composite the higher quality of C compared with B cannot be seen clearly but it is certainly a fact.

Nonetheless it is not always possible to obtain images at the desired time and the coming of digital imaging at least makes it possible in this case to obtain an image which is acceptable and which in the photographic darkroom would have been extremely difficult – if not impossible - to generate.

A poster in sci.astro asked why the moon appears larger on the horizon than at the zenith. The following responses appeared:

- Actually the moon appears so much larger because it is almost twice as close to you when on the horizon as it is when it is overhead.
- When the moon is on the horizon, it is attracted by all the mass of the Earth you see running from where you are standing to the point on the horizon where you see the moon. Up above you, there is no mass of Earth between you and the moon, so the force is less.
- The massive force brings the moon much closer when it rises and sets. As it gets higher, the force is less, and it moves further away. Then it comes back in again.
- The moon is actually closest to the Earth when below the horizon, only you can't see it then. Those of us on the other side of the Earth actually get a really good view. Apollo reached the moon by leaving from the other side of the Earth when the moon was close.

Paint Shop Pro Version 8 Processing

By Donald Waid

Paint Shop Pro (PSP) is a very powerful image processing program but many feel intimidated with using it to process astronomical images. It is very easy to import a regular snapshot into PSP and hit the "One Step Photo Fix" button and let it do all the work for you. Sadly you can not do this with most images taken of astronomical subjects. These images take a little more effort than a "one shot" button can provide. The range of brightness is just too great.

I've been asked by several of my fellow hobbyists to write up the steps that I use in PSP to process astronomical images. There is no hard and fast method of processing these difficult images. I've often used tools and methods to process one image and then used a completely different set of tools to process another image, even if the two images were of the same object! There is one thing to keep in mind as a rule of thumb.

Process to bring out faint details without overpowering the bright areas and without amplifying noise and other artificial data.

Alan Fader was kind enough to send me his raw image (at left) taken with a Meade LPI camera. He used Registax to stack the images.

I used this image and recorded my processing steps for this article. As you can see in the image, a few of the brighter stars show up well but not many of the fainter stars are readily visible. Rest assured they are there! Our job is to pull them out without displaying erroneous data, i.e. noise.

This is a grayscale image and therefore color issues are not dealt with in the article. I selected this image in order to simplify the processing steps. It is primarily an

exercise in brightness and noise control. Grayscale star clusters are relatively easy to process for this reason. Perhaps later, if some find this exercise helpful, I will prepare articles on color, planetary, and nebulae images.

Step 1: Initial Noise Reduction

The image was captured and stacked without dark subtraction. This leaves some hot pixels in the image. They may not be too visible unless you boost the brightness but they are randomly scattered across the image.

It is advisable to remove as many of these pixels as possible. I used the "Salt & Pepper" filter in the "Noise Reduction" menu to do this.

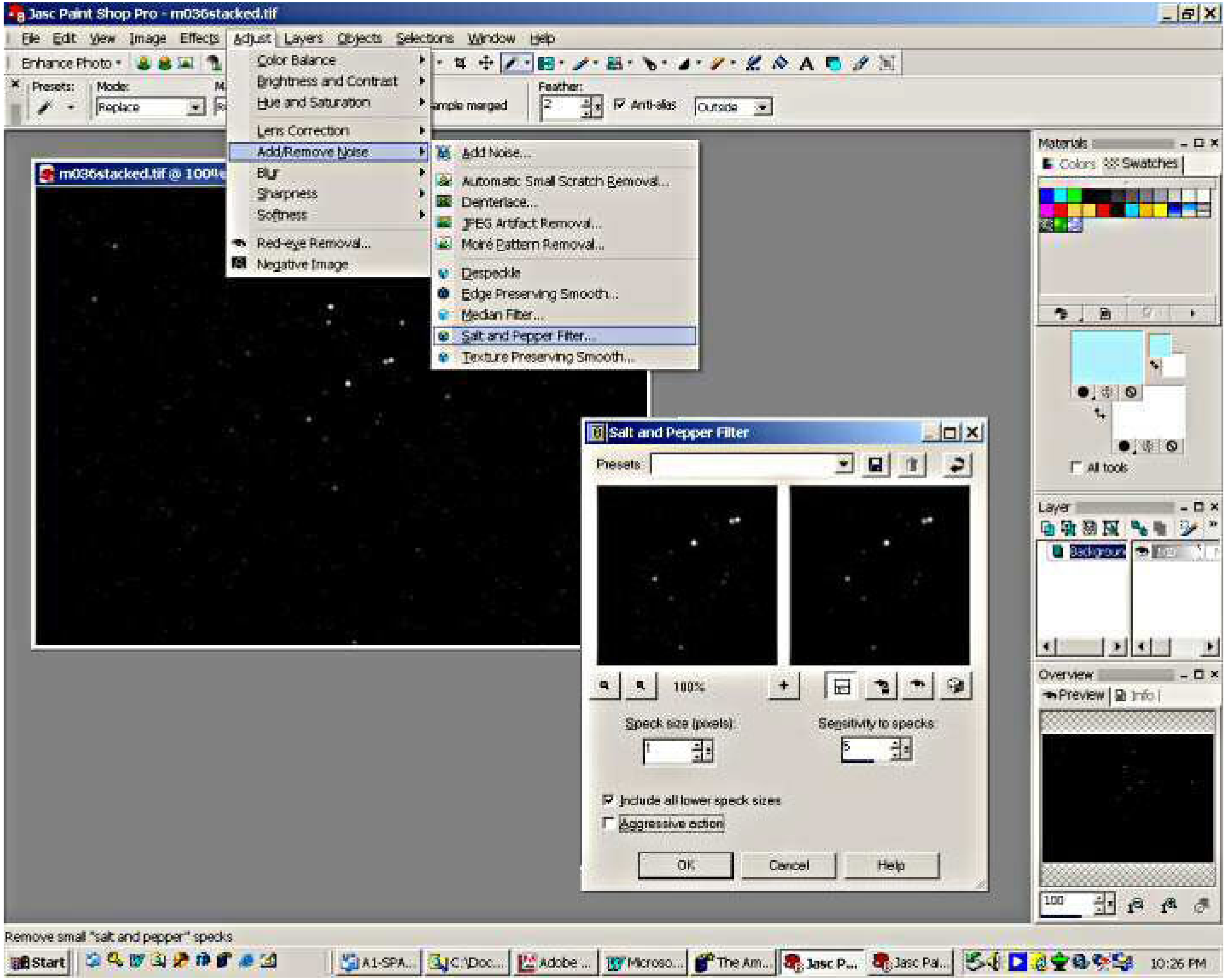
You just want to remove individual pixels so set the "Speck Size" to 1 and the "Sensitivity" to a mid range of 5.

If dark subtraction was used, this step can possibly be bypassed.

Step 2: Image Resize

On star cluster images such as this one, I like to work with the image resized to about twice normal. To do this I use the Smart Resize menu option.

Alan Fader's original image size was 640x480 pixels, si I set the image width to 1280 (640 X 2). Make sure the "Lock aspect ratio" box is checked/ticked.



Step: 1 Initial Noise Reduction

This enlarges the image and enables you to see faint detail better and to minimize artifacts that will be introduced by the following processing steps.

Step 3: Reduce Background Noise

There is noise in the background of the image. Although it is not easily seen at the current brightness level of the image, it is there. It will be a problem when the faint stars are "pulled" out with the use of curves. To lessen this noise problem I used a "Gaussian" blur. This is available from the "Adjust/Blur/Gaussian Blur" menu option.

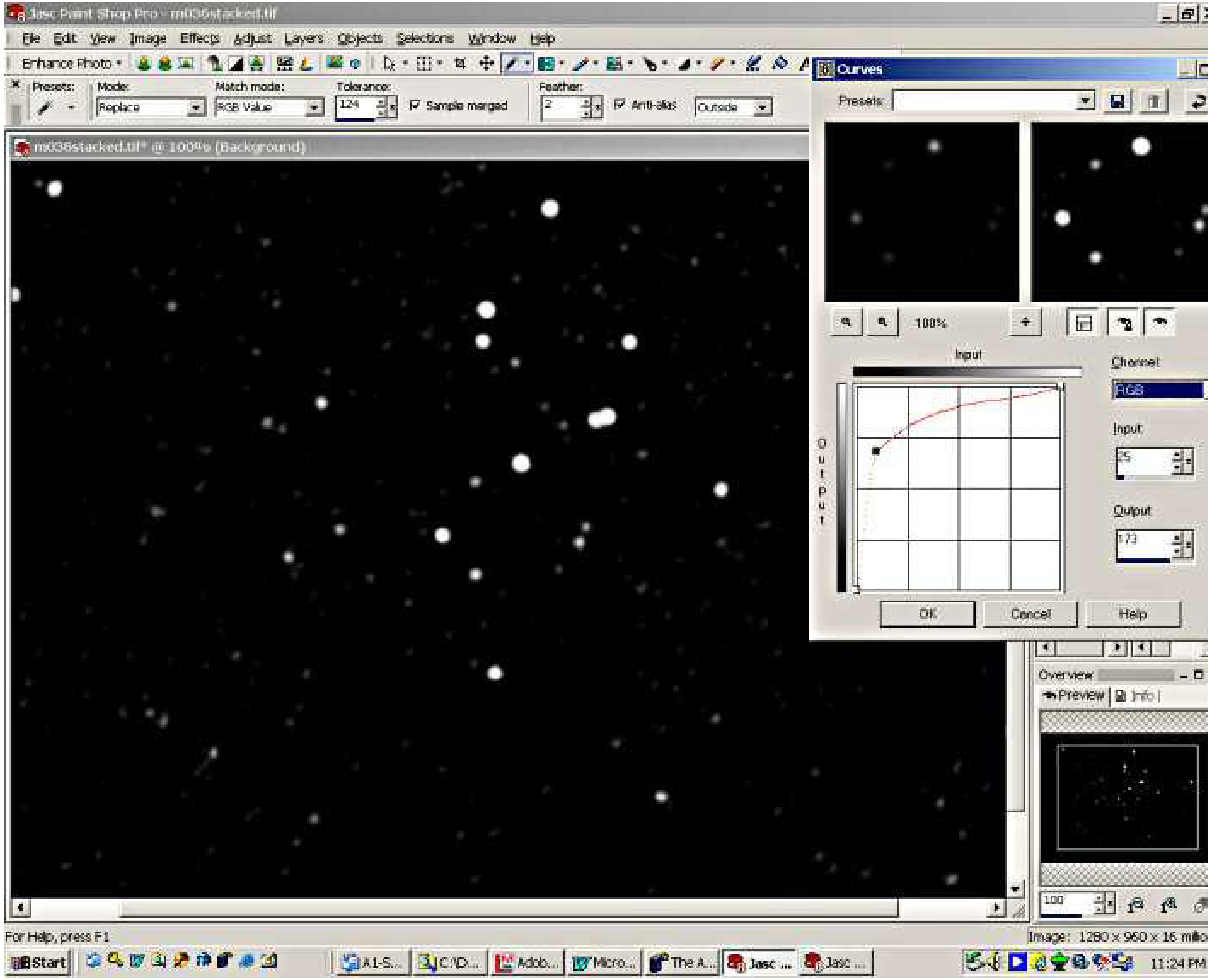
Use a radius of 2 pixels for this blur. You do not want to obliterate the stars but you want to smooth the noise in the background.

This reduces the star brightness a bit but don't worry, we will bring it back! The important thing here is to reduce the background noise.

Step 4: Using Curves

Now we use "Curves" to bring out the faint stars. This is probably the most important, at least the most dramatic, part of the processing task. The "Curves" feature of PSP is very powerful and proper use of it can be invaluable in astronomical image processing. This option is available from "Adjust/Brightness and Contrast/Curves".

Click on the curve and drag it up and to the left until the faint stars start to show. Do not over-do it here. We will apply this step again to bring out more stars. If you try to do it all



Step 4: First application of "Curves" to the image

at once you will start to bring out noise in the background. In this step the multiple use of curves is recommended. We will use 3 applications of curves on this image. With each application of the curves filter you will make progressively less of a change. Notice in the screen shots that the curve is "straighter" and the point is lower as you progress with the application of curves. You will need to experiment with the exact placement, but you see the general progression.

Use a second application of curves. PSP will remember the last filter setting and you should reset the curve filter before you apply it. Click on the little button in the upper right of the filter window to reset. This is the button with the little curved arrow in it. This feature is applicable to all filters.

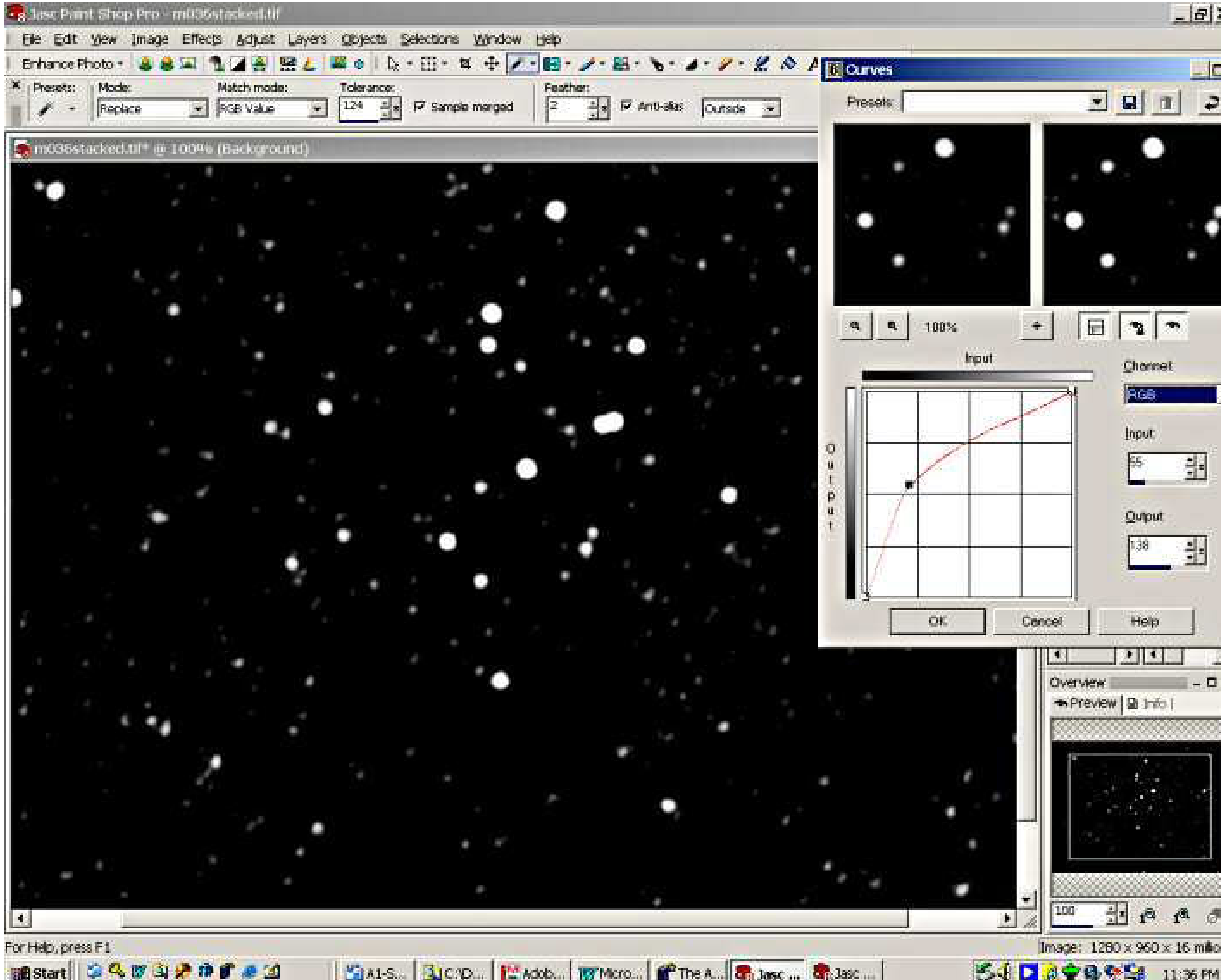
Now use the third application of curves (see next page). We're making progress!

Step 5: Noise Reduction

Now for the final clean up of noise before reducing the image back to normal.

Use a "Gaussian blur" as before with a radius of 2. (No screen shot here, just use the same procedure as was used earlier.) This will help reduce some noise that has been amplified with the use of curves in the previous step. This blurs the image but we take care of it with an application of "Unsharp Mask". This option is available from “Adjust/Sharpness/ Unsharp Mask”.

The sharpening will "tighten" the fainter stars



Step 4: Second application of “Curves” to the image

an also brighten them. I used a setting of 7 for radius and strength of 50 with clipping set to 0. You can vary these settings until the desired amount of sharpening is achieved. Don't over do it here. Remember we will be resizing back to the normal 640 X 480 resolution which will also effectively sharpen the image.

Now resize the image back to its normal size. Use "smart" resize and a setting of 640 in the width window. If the "Lock Aspect" box is checked the height window will automatically display 480.

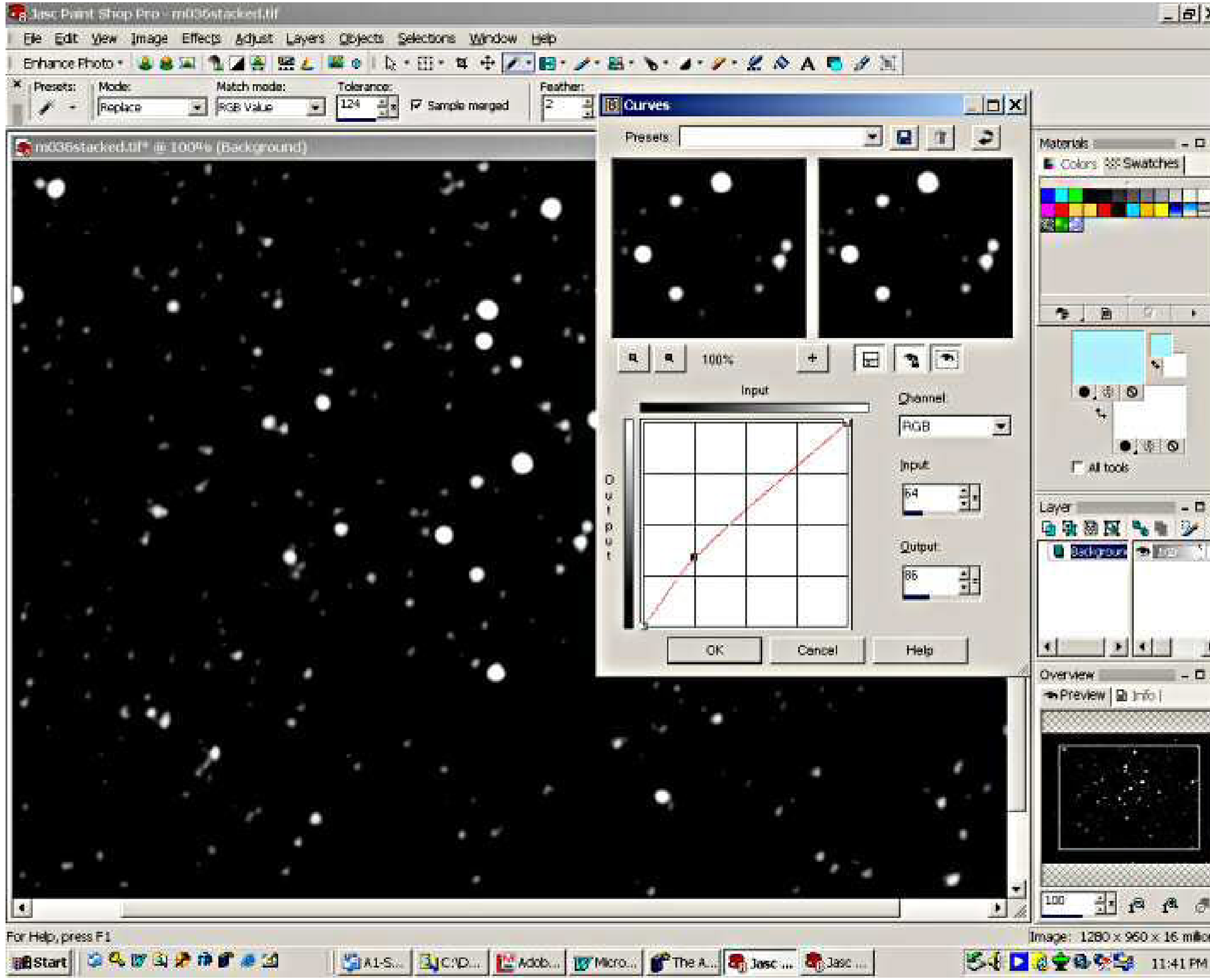
Step 6: Reducing Star Bloating

Some final enhancement can be made to the image by reducing the size of the brightest stars. They have been "bloated" by some of the processing. To reduce the size of the stars you select them with the "Magic Wand".

This is a tool on the main menu that looks like a wand with a glowing end. One of the tool’s options is “Magic Wand” and this is the tool we’ll use.

Set the "tolerance" to 100 and the "feather" to 1. Hold down the shift key and click on the brightest and biggest stars to select them. You will see a broken circle appear around the stars as they are selected. Be sure to click on the center of the star and not the black background or you will have to reset and start selecting again.

Now we apply the "edge erode" filter. This is



Step 4: Third application of “Curves” to the image

available from the "Effects/Edge Effects/ Erode" menu.

Once the "erode" filter is applied, the selected stars will be made smaller by a small amount. Repeated applications of the filter will reduce the stars more but be careful or they will not look natural. Only one application is used with our image.

Step 7: Final Tweaking

Now apply a final brightness tweak with curves and the image will be finished.

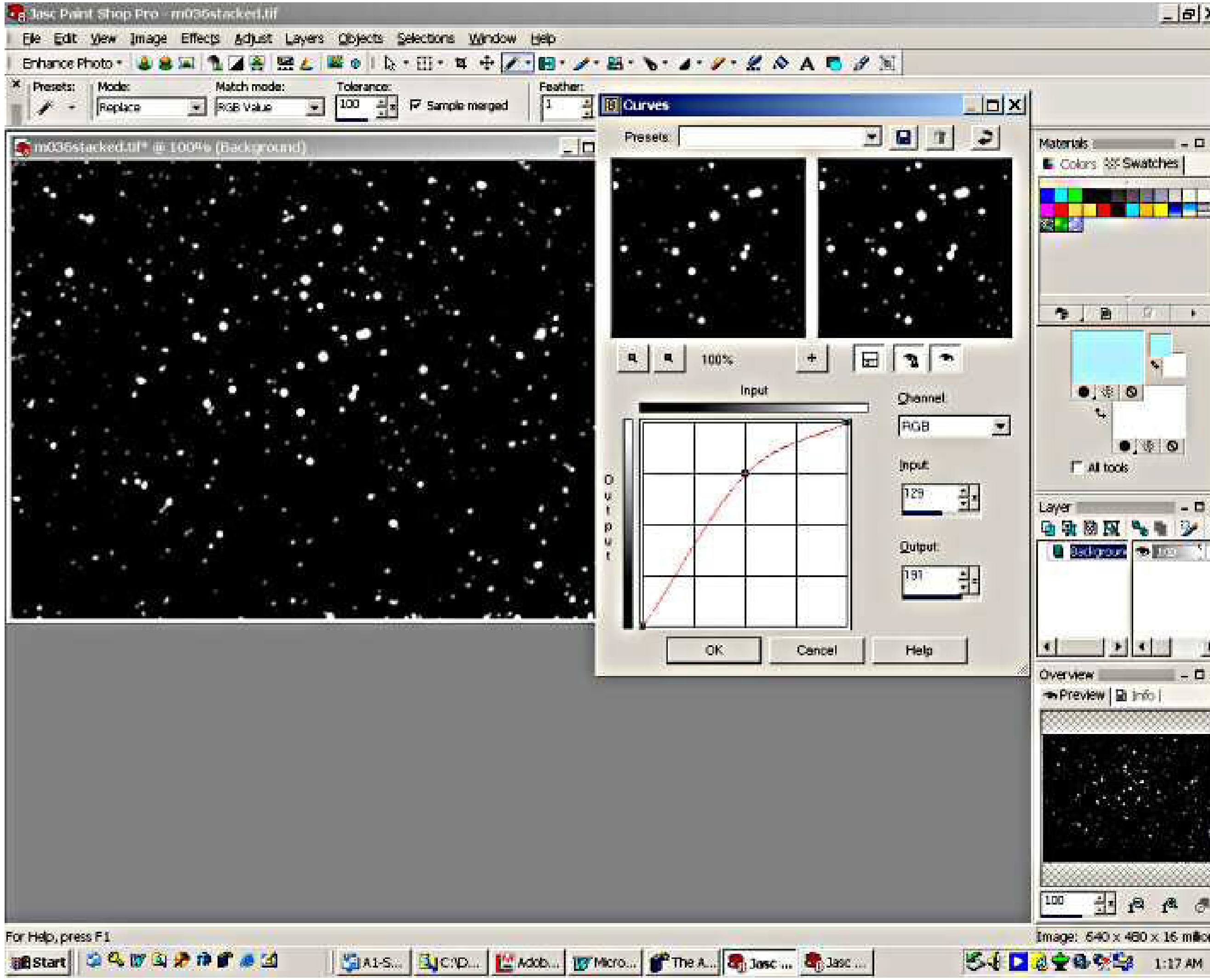
Notice the point is higher on the curve. This emphasizes the brighter portions of the image. A lower point would brighten lower brightness portions and would end up with "softer" stars. Just use your eye and adjust to the level you desire.

Final Image

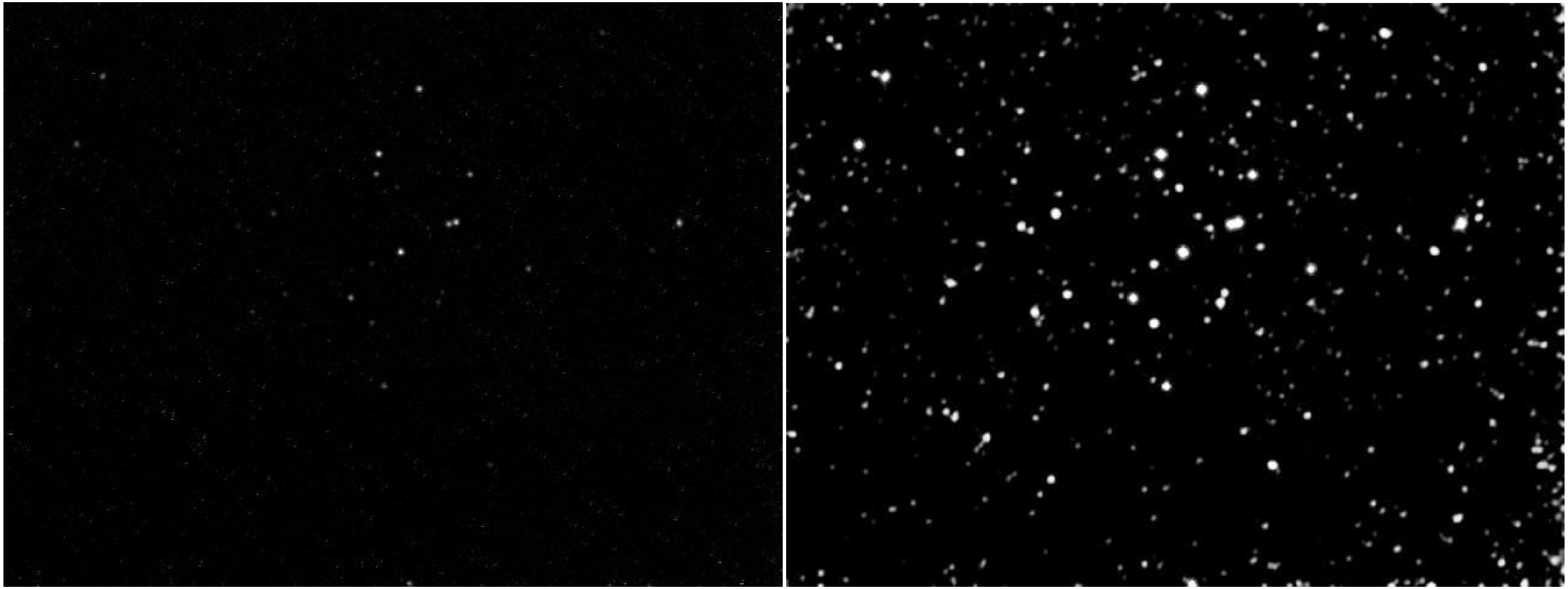
The final image appears on the following page. Compare it to the original image on the first page of this article.

We have only scratched the surface of what is possible with PSP-8. I purposely avoided using many of the tools available in order to keep this as simple as possible and still show basic application steps.

As you develop your processing skills, the use of such things as "histogram adjustment", "levels", "layers", etc. will be of great use in processing astronomical images. For now all I wanted to demonstrate are basic procedures that will get you up and running.



Step 7: Final tweaking with the application of "Curves"



Left: the original unprocessed image; at right: the final processed image

The Waid Observatory

Donald Waid runs the Waid Observatory, a privately owned amateur facility operated from two locations. The primary location is from his residence in Margate, Florida. The secondary site is from a residence maintained in the small community of Waurika, Oklahoma. The observatory is dedicated to the promotion and enjoyment of Amateur Astronomy and in particular to the imaging of the celestial wonders of the night sky.

Did You Know?

- Lightening is 3 times hotter than the surface of the sun. The surface temperature of our sun is around 6,000 degrees Celcius, while lightening is18,000 degrees.
- The presence of the Moon stabilizes Earth's wobble. This has led to a much more stable climate over billions of years, which may have affected the course of the development and growth of life on Earth.
- Scientists estimate that 1,000 tons to more than 10,000 tons of meteoritic material falls on the Earth each day. However, most of this material is very tiny - in the form of micrometeoroids or dust-like grains a few micrometers in size. (These particles are so tiny that the air resistance is enough to slow them sufficiently that they do not burn up, but rather fall gently to Earth.)

I SENT MY ROCK TO ARIZONA

By Deirdre Kelleghan

In November 2001, I registered with NASA to take part in the **'Send Your Name to Mars'** project. When the Mars Exploration Rover 2003 mission finally landed its two space probes on the surface of Mars, I knew then that my name and the names of 4 million other people from around the world had also landed on the red planet.

I have been following the progress of the mission since and I came across another interactive project connected with the Mars mission. The venture is called '**Rock Around the World**' and it calls on interested people to take part in a symbiotic and simultaneous experiment involving the analysis of rocks on Mars and on Earth.

This is an invitation from NASA to take part in a geological experiment where you literally send your rock to Arizona for NASA to analyse. You may think what is so special about that? Well, the equipment used to drill and analyse your rock is the same equipment used on Mars in the Mars Exploration Rover 2003 Mission. I posted my rock to Arizona in February 2004 and only recently I checked the Rock Around the World web site and got a nice surprise to discover my rock displayed on screen.

A map of the World is presented on the page peppered with red dots; each of the dots represents a rock received. On the map of Ireland, there was only one red dot that day, I clicked on it and there was my rock from Ireland; the spectral analysis was not completed as yet. The Rock Around the World project drills and analyses rocks from all over the World with the same newly developed drills (Rat's) that are carried on board the Mars Rover Explorers Spirit and Opportunity.

In order to look at the interior of rocks, a field geologist on Earth uses a rock hammer. On the Mars Rovers, the job of a rock hammer is done by the RAT — the Rock Abrasion Tool. The RAT is positioned against a rock by the rover's instrument arm and uses a grinding wheel to remove dust and weathered rock, exposing fresh rock underneath. The RAT exposes an area nearly 5 cm (2 inches) in diameter, and grinds down to a depth of about 5 mm (0.2 inches).

The rock particles are then brought inside the Rover and analysed by the Mössbauer Spectrometer. The Mössbauer Spectrometer sensor head is small enough to fit in the palm of your hand. It is one of four instruments mounted on the turret at the end of the rover arm. Its electronics are housed inside the body of the Rover (in the Warm Electronics Box, or WEB). Measurements are taken by placing the instrument's sensor head directly against a rock or soil sample. One Mössbauer measurement takes about 12 hours.

The Rock around the World project gives the scientists the ability to compare rock profiles on Mars with rock profiles on Earth. It tests these instrument's capability and endurance. It develops a worldwide profile of rock samples and has a database of interested people who perhaps might get involved in future experiments. This is a real time working study of these special drills (Rat's) and the analysis of the data produced.

The study would also help anticipate and problems that might occur with the drilling and the analysis of material focused on by Spirit and Opportunity as they go about their mission on the surface of Mars.

The Mars Rover Exploration Mission has been an resounding success and so far the rovers Spirit and Opportunity have surpassed their anticipated lifespan and are still being directed to different locations in the Gustav and Meridiani areas on Mars. The rovers have completed their primary requirements and are continuing their work on the red planet. The rovers were designed to discover evidence of liquid water in Mars' past, and they did so in dramatic fashion. Both rovers have had their missions officially extended by NASA to at least September, and will continue for as long as possible after that. People taking part in the Rock Around the World project will get:

- A certificate of participation from NASA
- Your rock will be analyzed by space technology
- An analysis of your rock
- Your rock will be presented on the Rock Around the World website
- Your rock will be placed in a museum of special rocks for study
- The fun of taking part no matter what age you are

To take part in the Rock project you must send a rock to Arizona and fulfill certain requirements (Detailed on next page):

Minimum Requirements	Optional Requirements
A rock – Minimum 2/ Maximum 6" (I sent a 2"X 4" rock)	Latitude /Longitude of location where rock was found. This can be achieved precisely by logging on to http:// http://www.heavens-above.com
Name	Name of geographic feature where rock was collected
Age	Copy of map with location Marked where rock was collected
Full Address	Photo of rock beside ruler for scale
Clean Rock	Photo of location where rock was collected
I wrapped my rock in bubble wrap and then in a jiffy bag. It cost € 10 to send it.	Short paragraph describing area where rock was found
Send your rock to: **Dr Phil Christensen** **Mars Space Flight Facility** **Arizona State University** **PO Box 876305** **Temple, AZ 85287 – 6305** **USA**	Website: http://marsdata1.jpl.nasa.gov/rockworld/rocks

The Man From Mars 2

Gerard Roy was a colorful character.

Known locally as The Man from Mars, he was the inventor (in the 1950s) of what was almost certainly the first pair of motorized roller skates.

One day while zooming along on his skates, powered by a lawnmower engine strapped to his back, Roy was stopped by the local sheriff - for exceeding the speed limit.

"He didn't get a ticket," his daughter, Elaine, later explained, "because the sheriff wasn't sure how to write it up."

Roy often skated in the Encinitas Christmas parades dressed as a space alien; the aptly-named street on which he was stopped? Vulcan Avenue.

The Man From Mars 1

One of the most unusual crime sprees to occur in San Gabriel was perpriated by none other than the "Man From Mars." The bandit was dubbed the "Man From Mars" because of the bizarre attire he wore while terrorizing supermarkets in the western San Gabriel Valley. The notorious bandit, later identified as 27 year old Forest Ray Colson, was described as a commuter bandit because he made it a habit to return to his parents' home in Oklahoma City, Okla., between robberies. Colson disguised his identity during the holdups by wearing a leather football helmet, goggles, gas mask, hood, and tight-fitting black clothes with boots resembling a motorcycle officer's uniform.

The "Mars" bandit staged five successful holdups of supermarkets in a six-month period netting more than $55,000 before his luck ran out on Thu. evening, October 12, 1951. Armed with a 12 gauge shotgun and a pair of 38-caliber revolvers on his hips, Colson entered the Boy's Market at 120 East Valley Blvd. and forced the cashier to turn over the evenings receipts, totaling $13,675. Before he could escape with his loot, however, Officer Harry Stone and his partner E.F. Nelson arrived on scene. The officers were just a block away when the call for "all available units" came out over their radio.

Soon after entering the store, Officer Stone noticed the bandit, dressed in his usual attire, stepping out of the cashier's office, a mere 54 feet away. As the two faced each other for a moment, the bandit appeared to lose his courage and made a last ditch effort to duck back into the office. Officer Stone reacted without hesitation and fired one shot with his 38-caliber revolver, striking the bandit once in the left side of his head. The bandit, who fell instantly to the ground, was still clutching his shotgun in one hand and the bag of cash in the other hand. Forrest Ray Colson, aka, the "Man From Mars" died two hours later at the jail ward of Los Angeles County General Hospital.

The original outfit worn by "The Man From Mars" at the time of his capture is on permanent display at the San Gabriel Police Department facility.

Faster Than Light!

An everyday story of country folk

By J.M. Harvey

I recently took my beautiful Celestron for a walk to 5°W, 50°N - that's near Porthleven in the far west of Cornwall, England. We had to guess the north point as it was far too bright to see Polaris but we planned to observe the first quarter Moon and a fast disappearing Venus. There was one other car there which I didn't take much notice of, even though I had parked quite close to him. He could hardly fail to see what we were about and after a while as he turned the car to leave he paused to enquire out of his window something like " 'Ere ! Wasson th'n ? See much can ee ?"

Well, who could resist that level of interest? However, his accent and manner belied a really lively mind as we later found. So I said " Like to have a look would you?" and ee, I mean he, said "Ez you". Well we started with Venus which was like a young Moon even at low power.

"My Gar" he said " I ain't never seen nothing like that there - I ain't never looked through one of these 'ere before". This kind of unstinting admiration always brings out the best in me and I encouraged more of it.

"We do come up 'ere to eat our fish-an-chips" he said " An do you knaw I'd rather look through this 'ere than go down pub for a pint".

As you can imagine, I was feeling great at all this, so I turned to the Moon and again invited him to look.

There was a total stunned silence for about thirty seconds .... and then; well, I can't write down exactly what he said but there was a fluent burst of explosive eloquence invoking numerous natural and supernatural deities, before he straightened up and rushed to his car " Ere! my Gar! you come and look at this ere missus". Well, missus had been silent hitherto but then said " I habb'n got me glasses". " No, No" says I, getting fuller by the second "You can focus the telescope to cope with that".

However, they both enjoyed themselves for a bit and we expounded lots of information about astronomy in general and our Society in particular until eventually they got back in their car.

A very astute side of our friend's imagination had been coming through in a lot of his questions and I genuinely enjoyed trying to keep pace with it - for instance. "Ere! Now!" said he, " Do you spose theres any life up there, not like us I don't s'pose, but all they stars an that, I reckon there must be don't you?" I had little chance to answer as he warmed to his theme. "Now see!" said he, - "We do take the kids on a bus sometimes up to town like Plymouth say, to show they the sights an that, don't us?". I wondered where the conversation was going for a second –

By now he was behind the wheel again and he turned to look at me over his right elbow - "Do you reckon they up there do take their kids like, on a trip down to see we; to show 'em some history like, of what we'm like?" I got the drift of this at last and started to invoke stellar distances and Einstein etc. " I should love to believe it" I said "but unfortunately nothing at all can travel faster than light".

"No!" Says he " Now thass where I disagree with ee - you'm wrong there". Blank astonishment on my modest features; had he not accepted all I had said until then without question? He continued: "You take a good woman with a dinner plate boy , my Gar! - She'll shift!"

My turn for stunned silence as he drove off. Well there you have it - relativity Porthleven style!

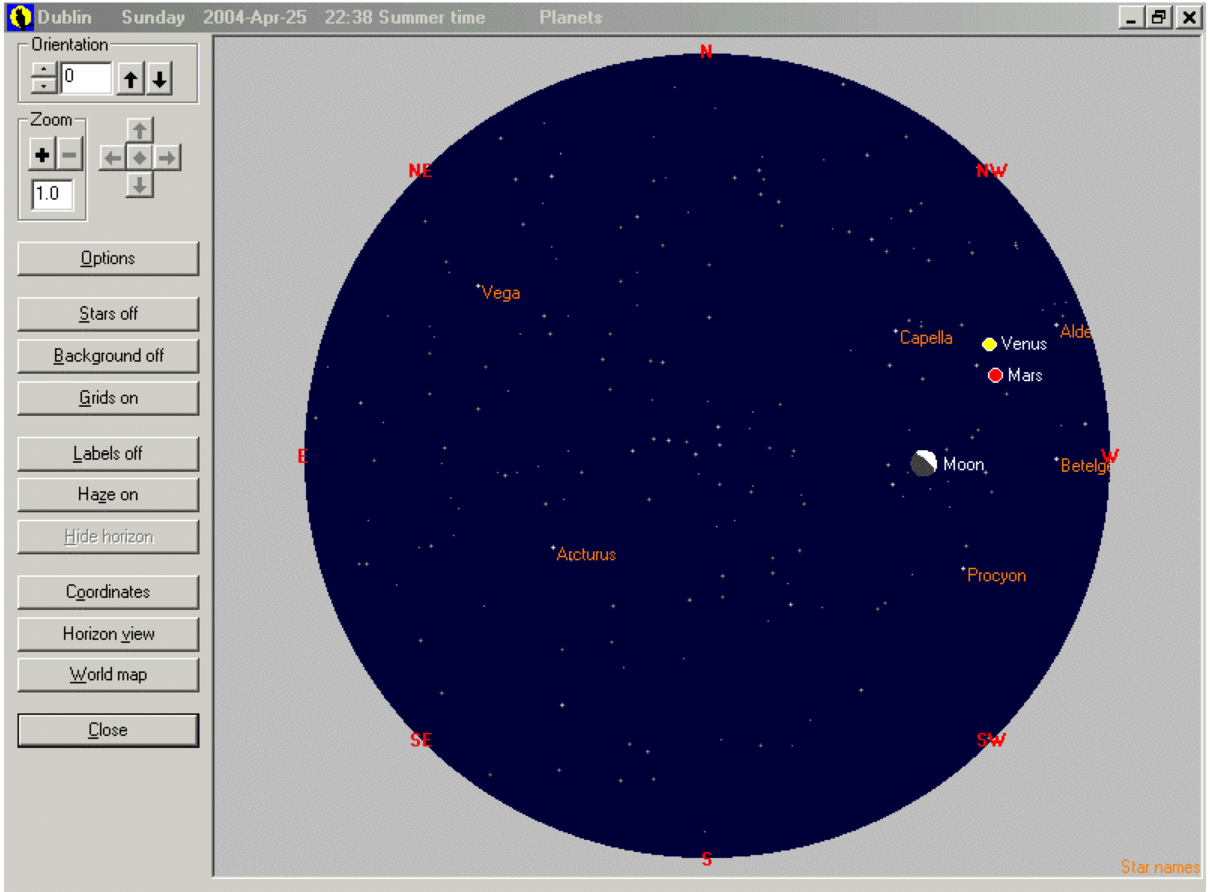
But I thoroughly enjoyed my evening and learned a thing or two.

Carl Sagan: BHA

Software designers often bestow pet names upon their projects. When Apple programmers named a beta (test) version of a novel software application "Sagan" in honor of the renowned astronomer Carl Sagan, the latter - incredibly - threatened to sue. Naturally, Apple backed down, renaming the application "BHA". Only later did Sagan discover that the new name was in fact an acronym - for "Butt-Head Astronomer"!

Software Review: GraphDark V2.04

By John O'Neill



Occasionally I am asked a question: "when can I see Mercury?". Or maybe when will be the best period to see this new comet?

One convenient way is to consult a graphic timetable. A graphic timetable is a graph that shows the time when astronomical events occur. Any position on the graph stands for a specific time on a particular date. Curves indicate sunset and sunrise as well as end of twilight. Also there are curves plotted for the planets and bright stars.

Enter **GraphDark**, a full featured graphic time table program written by Richard Fleet of the Newbury Astronomical Society (N.A.S.) in England. The great advantage of a computer version is one can select their own location on the earth. People are often surprised that a few degrees shift in geographic latitude can make such a big difference in object visibility.

The opening screen displays the characteristic hourglass shape with colourful curves representing the rise and set times of the sun and planets. Clutter may be reduced by switching off objects not of interest. Figure 1 show the chart with Mercury, Venus and Mars left on, moonlight shows as silver. As well as all the planets there are also comets, asteroids, meteor radiants, stars and deep-sky objects. New objects can be entered manually or more conveniently imported from file.

Figure 2 shows the apparition of Comet NEAT (C/2001 Q4) in May 2004.

The user can select from a number of twilights more to their liking. In a city the end or start of Nautical Twilight (sun 12º below horizon) might be more appropri-

Fig. 1: At left: Venus and Mars in late April

ate than Astronomical Twilight (sun 18º below horizon). Haze near the horizon may also be indicated.

I was pleasantly surprised when I right clicked on a particular point on the graph when a new window popped up showing an all-sky map with the objects on the graph plotted. Figure 1 shows a view in late April when Venus and Mars are close together.

As well as the all-sky maps there are horizon and earth maps. The horizon maps are similar to the all-sky map. The earth maps shows day, twilight and night and where the object is above the horizon. For more precise information there is a table with equatorial and horizontal coordinates. There is also a simple lunar calendar showing the phase for the month.

Normally the computer screen can only show the chart for part of a year. Although you cannot vary the interval from one day, there is a option to reduce

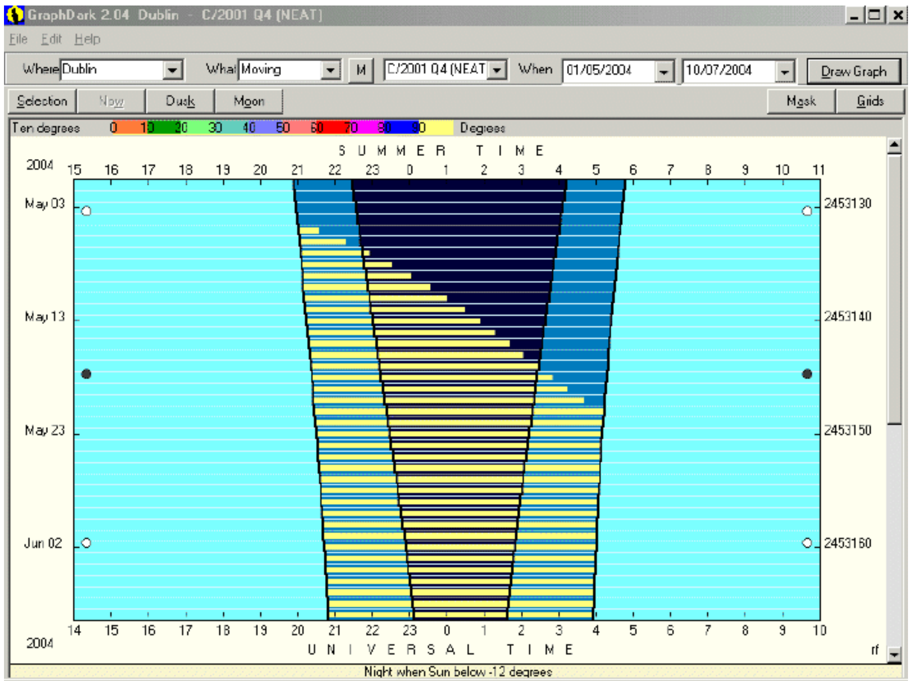


Fig 2: Comet NEAT (C/2001 Q4) Apparition

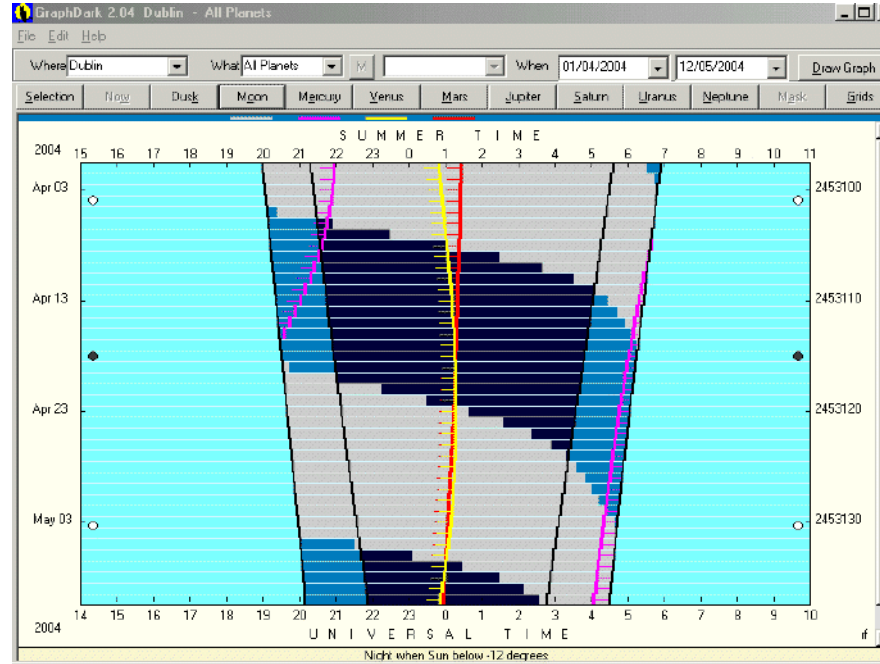


Fig. 3: Rise and set times of planets

the width of a day taken up in pixels. On my 1024x768 display a width of one pixel per day fitted a whole year on the screen.

Virtually everything imaginable is extensively customisable from line widths to colours. There is a help built into the program.

GraphDark is freeware and may be downloaded from the N.A.S. Site: **http://www.newburyas.org.uk**

Who will benefit from this program? It will probably appeal to observers and those starting in astronomy that are a little beyond the beginners stage. All in all highly recommended.

The Great Astronomers

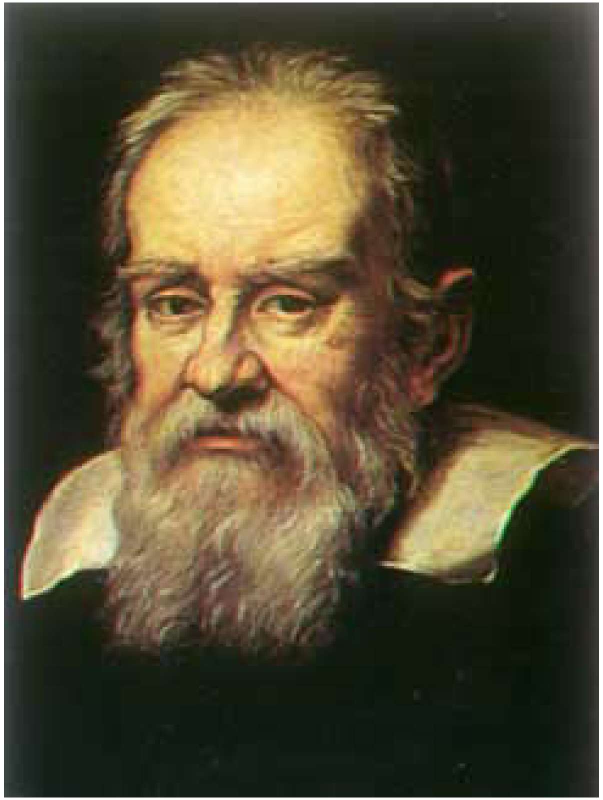
What Has Philosophy Got to do with Measuring Anything?

By Tim Carr

Popular opinion has it that this man invented the telescope, and is best remembered for discovering the four major satellites of Jupiter, which collectively bear his name - the Galilean satellites

In the early 1970's an American astronaut stood on the Moon, holding a feather in one hand and a hammer in the other. He dropped both of them simultaneously, and millions of people around the world watched both feather and hammer hit the surface of the Moon at the same time. If it were not for a similar experiment carried out by an Italian, some four centuries ago, we might still be waiting to just get off the ground.

Galileo Galilei was born in Pisa in 1564, the son of a talented and influential musician. His father wanted him to study medicine, partly on the basis that a doctor earned about thirty times as much money as a mathematician, which was what Galileo wanted to become. Luckily for us, fate intervened in the shape of a swinging chandelier.



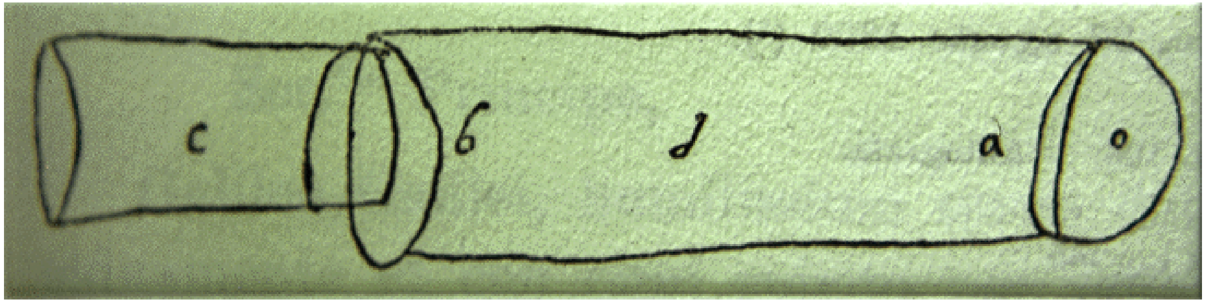
A portrait of Galileo by Justus Sustermans painted in 1636

In 1581, Galileo attended mass in the cathedral at Pisa. From the ceiling hung a chandelier which swung in the draft. What he noticed was, that no matter how long or short the swing, the length of time for one swing was always the same. Most people would have paid little attention to this, but Galileo was not like most people. He used this discovery to carry out experiments into measuring time accurately. If it had not been the chandelier, it probably would have been something else, but Galileo had started down the path that would change his life forever. In 1585, the family had to move back to Florence, where they had originally come from, for financial reasons. Galileo had no degree yet, but he was able to finance his scientific work by private tutoring, and in 1589, he talked his way into the Chair of Mathematics in Pisa.

Galileo used the time at Pisa to carry out his most important experiments, concerning the movement of bodies. According to Aristotle, the speed at which a body fell to earth depended on how heavy it was. As far as Galileo was concerned, Aristotle was wrong on this matter, (and just about everything else). He probably didn't conduct the famous experiment of dropping cannon balls from the Tower of Pisa, but by rolling different weights down a gently inclining slope he discovered that not only did they hit the ground at the same time, but that they accelerated at the rate of 32 feet per second/per second. In other words, unless air resistance gets in the way, all bodies will hit the ground at the same time if simultaneously dropped from the same height. Also, in the first second, a body will fall 32 feet, in the next second it will fall 64 feet, in the third second it will fall 96 feet, and so on. Leonardo Da Vinci had noticed some of this a century before, but told nobody. Galileo noticed it and told everyone.

The Professor of Mathematics had effectively founded experimental mechanics, and at the same time began a lifelong battle against the philosophy of Aristotle, which had held such a stranglehold on intellectual life in Europe for so long.

Like the great Danish observer, Tycho Brahe, before him, Galileo was a great scientist and a poor diplomat. If Aristotle was wrong, then so were the other profes-



The earliest known illlustration of a telescope.
Giovanpattista della Porta included this sketch in a letter written in August 1609

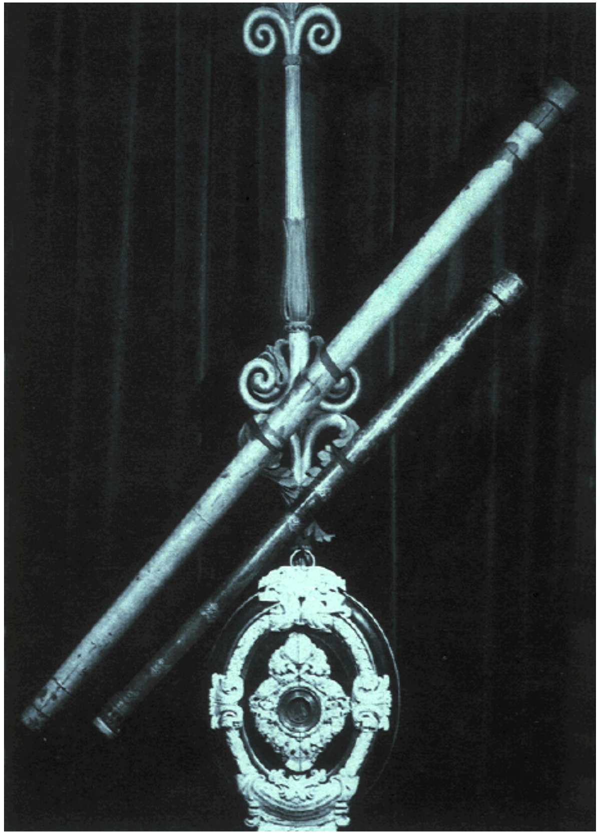
sors at Pisa who taught his work. They resented Galileo, and this unfriendly atmosphere, along with money troubles, led him to become Professor of Mathematics at Padua, in 1592. Padua was ruled by Venice at the time, and its liberal climate gave Galileo the happiest time of his life.

All this time, Galileo had preached the Ptolemaic system of the Universe, even though he no longer believed in it. In 1597, he wrote in a letter to Johannes Kepler, indicating that he now believed in the teachings of Copernicus, that the Sun was the centre of the Universe. So why should he teach the wrong system? Simple. To teach anything else would risk the wrath of the Catholic church. Giordano Bruno tried it in 1600, and was burned at the stake for his trouble. The Ptolemaic system was in keeping with the views of Aristotle, so it must be right. For some years, Galileo continued to lecture at Padua, drawing huge audiences, much to the resentment of his colleagues, making as many enemies as friends with his rapier-like wit.

In 1609, fate intervened one again, when Galileo heard of the invention of the telescope in Holland, (probably by Hans Lippershey). One or two others had pointed these instruments at the sky before Galileo, but no one was to use it to such effect as he. The telescope he used was of his own making, and it was, by modern standards, quite crude, with a small aperture and a magnification of only about 30x. But it was enough. During the winter of 1609-1610, Galileo made a series of observations which would change the science of astronomy forever.

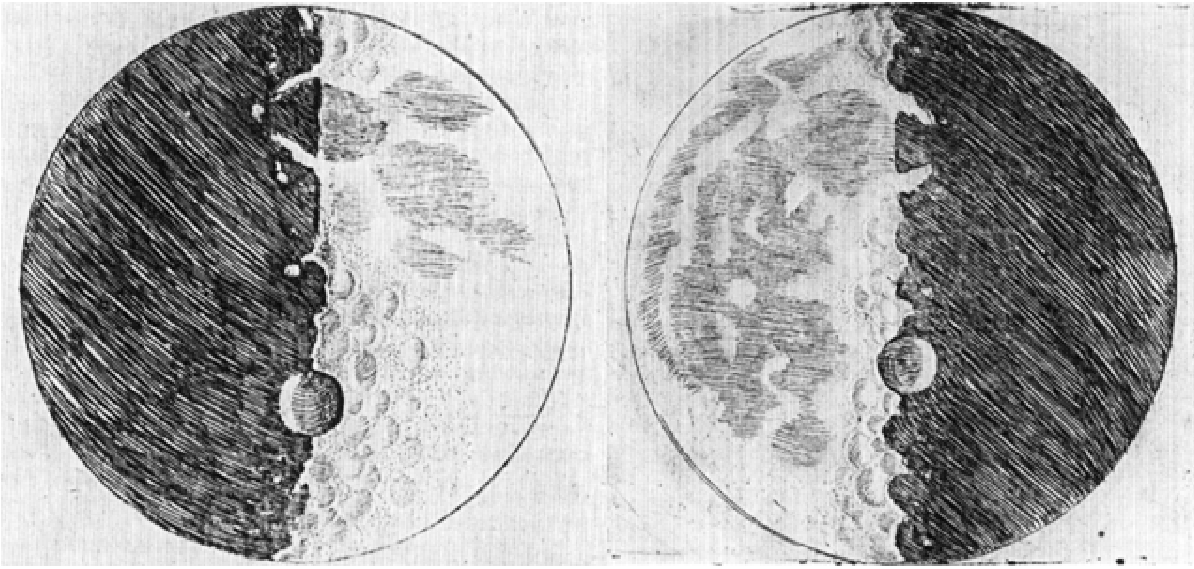
When he pointed the telescope towards the stars, he found that seemingly no amount of magnification would make them appear bigger, showing that they must be very far away compared to all other bodies "orbiting" the Earth. Not only that, there was a seemingly endless number of them. There were not hundreds or thousands of them. There were millions. The Milky Way was made of endless numbers of stars. Clearly the universe was a much bigger place than Aristotle had thought. The Sun had irregular spots on its surface, and Galileo used them to discover the Sun's rotation period of 27 days.

When he looked at the Moon, he found it to be not at all the perfect, smooth body that Ptolemy and Aristotle said it was. It had craters, mountains, valleys and seas.



Galileo's Telescopes

(He understandably mistook the lava plains for seas). But, not content with describing the surface of the Earth's natural satellite, he used the shadows of the Moon's mountains to determine their height by trigonometry. He also reasoned that the phenomenon of "Earthshine" was light being reflected back from the Earth and onto the Moon's surface. But there was still more.

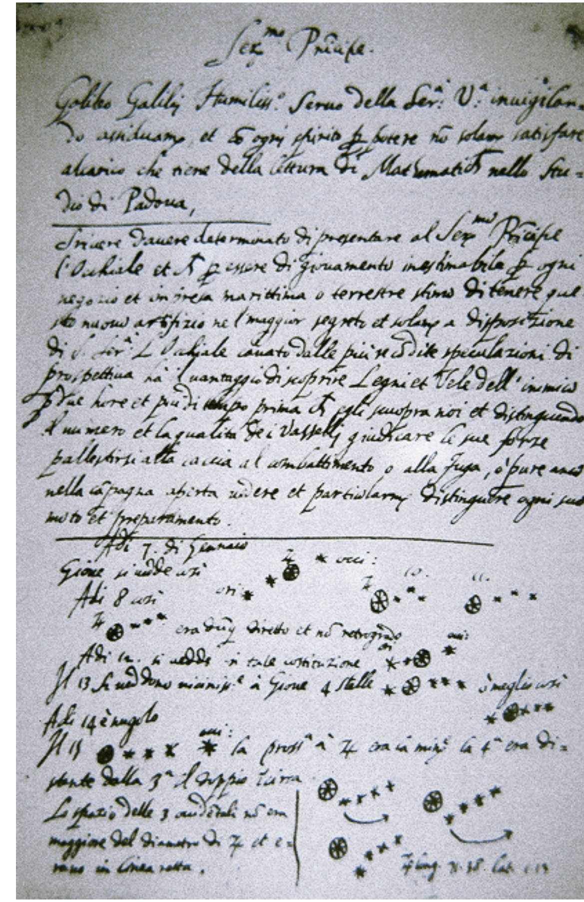


Galileo's drawings of the Moon made in late 1609

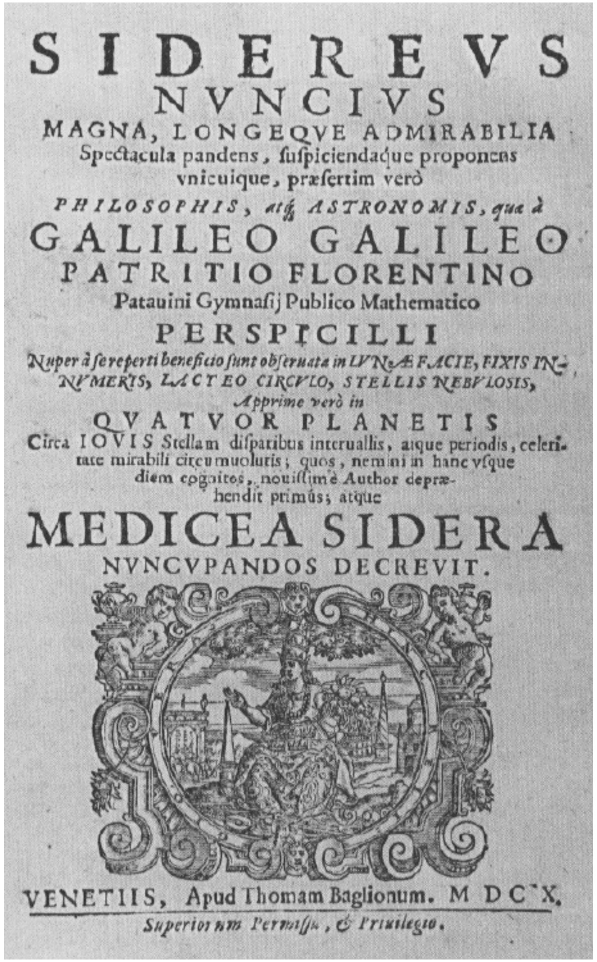
The telescope might not show any detail on the stars, but it certainly showed plenty on the planets. If Ptolemy was right, then Venus orbited the Earth closer than did the Sun, and from Earth, Venus could not be seen in Full or Quarter phase. However, in Galileo's telescope, Venus could be seen in Full, Quarter and Gibbous phases. The only explanation was that the Earth orbited the Sun, as did Venus.

The greatest planet of them all is the gas giant, Jupiter. Galileo discovered that it had four smaller planets orbiting around it. Originally he was going to name them after the four children of the Grand Duke [Cosimo II](#) of Tuscany. Thankfully, wiser heads prevailed, and they were given the names [Io](#), [Europa](#), [Ganymede](#) and [Callisto](#), all figures from Greek mythology. The enormous significance of this discovery was, that for the first time, celestial bodies were found which could not possibly orbit the Earth.

With these discoveries, Galileo proved, once and for all, that both Copernicus and Kepler were right, and that Aristotle was wrong. The impact of this on the philosophical and religious life of Europe can hardly be overstated. Copernicus was an obscure Polish cleric who could be ignored. Hardly any member of the public had read his book anyway. Kepler was a German Protestant, who could simply be dismissed as a dirty heretic. Galileo was, on the other hand, a Catholic. He was also Italian. Worst of all, he was well known. His was a voice that boomed out all over Europe, one that could not be ignored.
Galileo published his findings in a periodical called `[Sidereus Nuncius](#)' - The Starry Messenger. The reaction to it was both good and bad. As the best telescope maker in Europe, his instruments were in great demand, (especially by merchants who wanted them for looking out to sea to determine what ships were coming in to harbour). So impressed was the Grand Duke



Galileo's observations of Jupiter's moons from manuscripts


SIDEREVS
NVNCIVS
MAGNA, LONGEQVE ADMIRABILIA
Spectacula pandens, suspiciendaque proponens
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PATRITIO FLORENTINO
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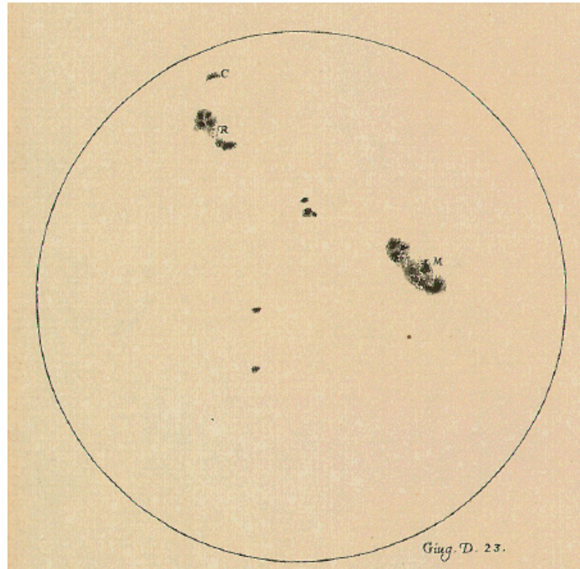
PERSPICILLI
Nuper à se reperti beneficio sunt obseruata in LVNÆ FACIE, FIXIS IN-
NVMERIS, LACTEO CIRCVLO, STELLIS NEBVLOSIS,
Apprime verò in
QVATVOR PLANETIS
Circa IOVIS Stellam disparibus interuallis, atque periodis, celeri-
tate mirabili circumuolutis; quos, nemini in hanc vsque
diem cognitos, nouissimè Author depræ-
hendit primus; atque
MEDICEA SIDERA
NVNCVPANDOS DECREVIT.
VENETIIS, Apud Thomam Baglionum. M DC X.
Superiorum Permissu, & Priuilegio.

Title page of Galileo's Sidereus Nuncius, published in Venice in 1610. The book instantly made Galileo a European celebrit. The book described Galileo's groundbreaking telescopic discoveries including his lunar observations, and discovery of Jupiter's four larger Moons



Galileo's Sunspot drawings

of Tuscany, that he forgave Galileo his previous rudeness, and invited him to become "Chief Mathematician of the University of Pisa", and "Philosopher to the Grand Duke". The authorities at Padua were less than pleased at his decision to move, but the money on offer was too good to refuse. He should have stayed where he was. Another person who agreed was, not surprisingly, Kepler. He was sent a copy of the Starry Messenger and asked for his opinion. His reply was published as `The Conversation with the Sidereal Messenger'.

In 1611, Galileo visited Rome, and was well received there. He began to become a little over-confident about what he could and could not say in public. He wrote a book giving his views on the Bible, which did not help matters. His critics intimated that it was defects in his telescope that caused him to see all these things in the sky.

In 1610, Martin Horky had published `A Very Brief Excursion Against The Sidereal Messenger'. It was one of many publications that attacked Galileo. The storm clouds were gathering, and in 1614, a young Dominican named Caccini, delivered a sermon attacking Galileo, Copernicus and almost every other scientist he could dream of. Caccini was out to make a name for himself, and succeeded in making trouble for Galileo. A letter written by Galileo to Castelli in 1613, in which he said that the Bible should not be used to support one scientific view or another, fell into the hands of Galileo's enemies. Galileo issued a revised version of the letter, which should have ended the affair, but the attacks continued. Finally, in 1616, Galileo was told by the Commissary of the Inquisition that he was forbidden to hold, defend or teach the views that he held. The Commissary had actually exceed his authority, and Cardinal Bellarmine, a close friend of Galileo, assured him that as long as Pope Paul was alive, he need fear no threat of physical harm. Galileo continued his scientific work, and with the election of a new pope, Urban VIII, he felt it was safe to publish his masterwork, `The Dialogue'.

It took the form of a conversation between a supporter of Copernicus and a supporter of Aristotle, arguing over which was the true system. The Copernican, of course, won, but Urban VIII, although personally not opposed to Galileo, was unwilling to rescind the order of his predecessor. (NB: What Order - What predecessor?)

In 1633, Galileo was called to Rome to face the Inquisition. He was ordered to never again preach any views that were at variance with Aristotle. There were to be

no more lectures, no more books and no more "heresy". To his horror, he was sentenced to house imprisonment for life, and only the help of friends prevented him from an early death.

He lived out most of the rest of his life in a villa in Arcetri, where he discovered the rocking motion of the Moon, termed `libration'.

Galileo died in 1642. His desire had been to protect the church from its own folly, by persuading it not to take up doctrinal stances on scientific issues. Philosophy had nothing to do with measuring anything. Eventually, even the church would come to that conclusion.

His published works were placed on the list of prohibited literature by the Vatican, and when he died he was buried in unconsecrated ground. The church thought that they had silenced him, but they had not. Galileo had taken the established philosophy of Aristotle, and dealt it a mortal blow. He was important because he made it respectable to experiment in a world that had previously accepted Aristotle's word as truth, important because he discovered that the Universe was a much bigger and grander place than anyone had ever thought, important because he proved Copernicus right and because he showed that the Universe could be understood, and was worth understanding.

Further Reading

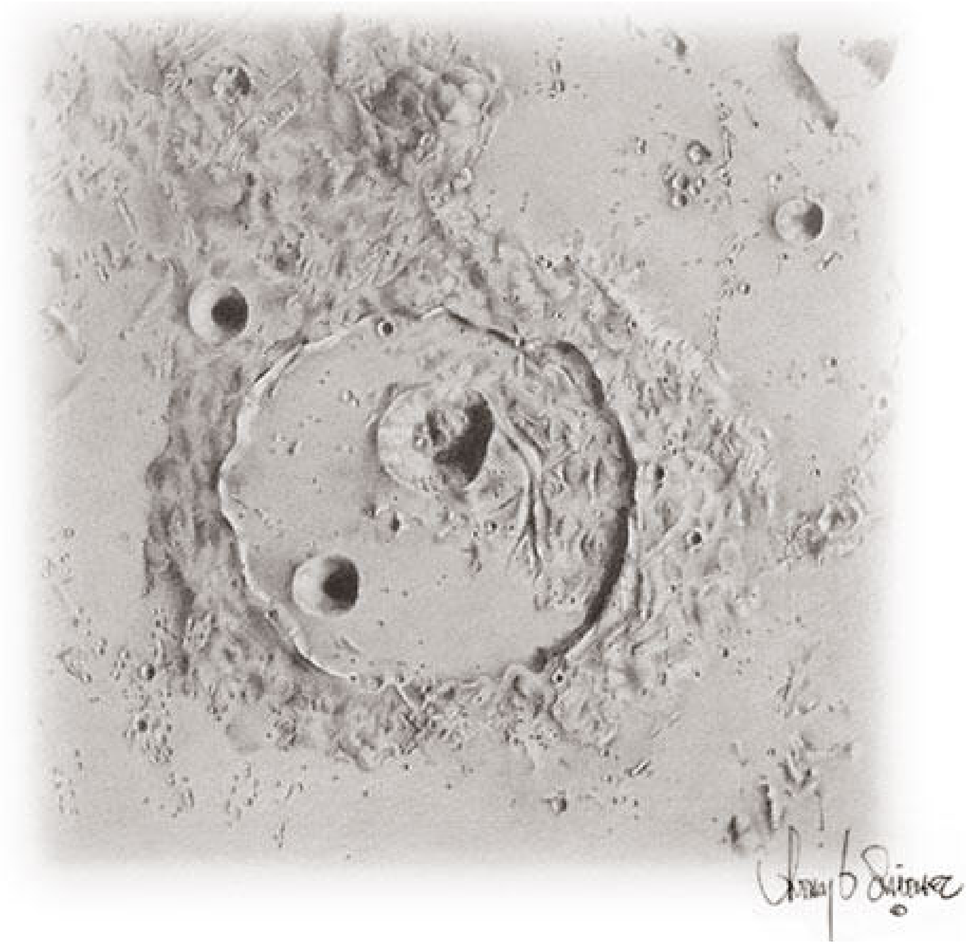
Galileo's Heresy
Accessing Galileo's Maunscripts
"Dialogue Concerning the Two Chief World Systems", full text, published in 1632
The Trial of Galileo, 1633
Galileo and the Telescope

Showcase

If you have images/photos, please consider sending them in.

Cover Picture: Captured using a Celestron 102mm achromatic refractor that was piggybacked on a LX200GPS telescope. Camera: SBIG ST-10XME Exposure: L = 60 min. R&G = 21 min. each B = 42 min. Imaging Location: Margate, Florida (20 miles from Ft. Lauderdale, Florida). © Don Waid.

Left: A pencil drawing of lunar crater Cassini, 8x8 inches, pencil on Illustration board. "I used Lunar Orbiter imagery and spent about 4 hours at the eyepiece of my Intes Micro M603, to complete the drawing in about 40 hours." © Anthony G. Sanchez



Bottom: Transit of Venus on June 8th taken in mid-afternoon from Crete. Canon EOS Rebel 300D with an 80-210mm zoom lens at 210mm. A mylar white-light solar filter was held in front of the lens while the picture was being taken. © Gary Nugent

Submissions

We're looking for submissions for the next and future issues, whatever part of the world you live in.

Issues 1 and 2 should give you a flavor for the kind of articles we're looking for. Tell us about any astronomical trips you've been on, whether they're to local or national Star Parties or vacations based around an astronomical event such as a solar eclipse. Give us warts-and -all reviews of equipment you own, from a lowly pair of binoculars, to eyepieces to large expensive telescopes. Let us know what you think of recent books on astronomy or your appraisals of astronomy software, whether they're freeware, shareware or commercial applications; profile your club or society; tell us about any equipment you've built or modified; tell us about your experiences with astrophotography and send us some of your results. We will be paying for any material used in future issues.

Please include any photos or illustrations with your submission. You should own copyright on any photos submitted (i.e. you've taken the photos yourself) or have obtained permission from the copyright owner.

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Material received by any means other than email will not be returned unless a submitting author specifically requests the return of material and a stamp addressed envelope or sufficient return postage is included.

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Contacts

Editor: Gary Nugent
photonmag@excite.com

Editorial Address:

Photon,
54a Landscape Park,
Churchtown,
Dublin 14,
Ireland.

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